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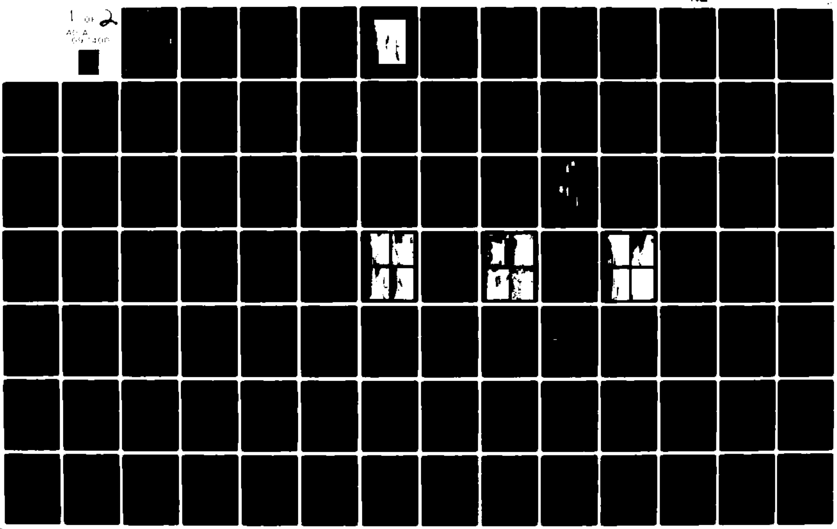

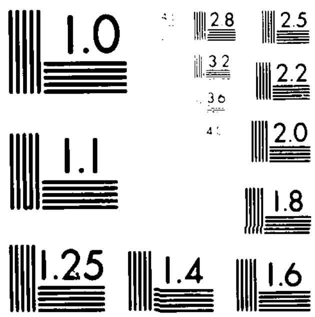

MICROCOPY RESOLUTION TEST CHART

LEVEL II

DELAWARE RIVER BASIN
BEAR SWAMP RUN, MONROE COUNTY

~~PENNSYLVANIA~~

MONROE LAKE DAM

NDI I.D. ~~NO.~~ PA-00633
PENNDER I.D. ~~NO.~~ 45-117

MONROE LAKE PRO~~PERTY OWN~~ERS ASSOCIATION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

(10) M./Mihalcin

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland ~~21203~~

(15) DACW 31-81-C-0015

PREPARED BY

(12) 95

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

(11) JAN~~UARY~~ 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Design Flood is based on the estimated Probable Maximum Flood (greatest reasonably possible storm runoff) for the region, or fractions thereof. The Spillway Design Flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

Breach analyses are performed, when necessary, to provide data to assess the potential for downstream damage and possible loss of life. The results are based on specific theoretical scenarios peculiar to the analysis of a particular dam and are not applicable to other related studies such as those conducted under the Federal Flood Insurance Program.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Monroe Lake Dam: NDI I.D. No. PA-00633

Owner:	Monroe Lake Property Owners Association, Inc.
State Located:	Pennsylvania (PennDER I.D. No. 45-117)
County Located:	Monroe
Stream:	Bear Swamp Run
Inspection Date:	20 October 1980
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and hydrologic/hydraulic analysis, the dam is considered to be in fair condition.

The size classification of the facility is small and the hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possible loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store approximately 30 percent of the PMF prior to embankment overtopping at the low area in the embankment crest. Breach analysis indicates that failure under a 0.35 PMF event or larger could lead to increased downstream damage and potential for loss of life. Thus, based on screening criteria provided in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

Calculations also indicate that if the embankment crest was uniformly regraded to the design top of dam level at elevation 996.0 feet, the facility could pass and/or store approximately 60 percent of the PMF prior to embankment overtopping. Consequently, the facility would be considered inadequate rather than seriously inadequate. In addition, the spillway capacity could be increased to about 75 percent of the PMF if the downstream roadway were modified to enable unrestricted flow.

It is recommended that the owner immediately:

Monroe Lake Dam: NDI I.D. No. PA-00633

a. Uniformly regrade the embankment crest to the design top of dam level at elevation 996.0 feet under the direction of a registered professional engineer experienced in the construction of earth dams. If it desired not to perform the above remedial work, the owner should immediately retain the services of a registered professional engineer experienced in the hydrology and hydraulics of dams to further assess the adequacy of the spillway and prepare alternative recommendations for remedial measures deemed necessary to make the facility hydraulically adequate.

b. Clear all obstructions from the road culvert immediately below the outlet to allow the inundated area along the downstream embankment toe to drain and, subsequently, locate the source(s) of any seepage and/or leakage. Furthermore, any seepage and/or leakage observed should be assessed in all future inspections noting any turbidity or changes in rates of flow.

c. Repair the deteriorated concrete associated with the spillway weir and wingwalls.

d. Replace the deteriorated entry door and stop logs associated with the outlet riser.

e. Develop formal manuals of operation and maintenance to ensure the proper future care of the facility. Included in these manuals should be a formal warning system to notify downstream inhabitants should hazardous embankment conditions develop. The system should include provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
BERNARD M. MIHALCIN
ENGINEER
20371-E

Date 26 JANUARY 1981

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date 4 MARCH 81

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OVERVIEW PHOTOGRAPH

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MONROE LAKE DAM
NDI # PA-00633, PENNDER # 45-117

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Monroe Lake Dam is an earth embankment approximately 12 feet high and 390 feet long, including spillway. The facility is provided with an uncontrolled, rectangular shaped, concrete spillway located at the right abutment. The spillway is equipped with an ogee-like weir, 50 feet in length. The outlet works consists of an 18-inch diameter cast iron pipe that discharges at the downstream embankment toe. Flow through the conduit is manually controlled by an 18-inch diameter sluice gate located at the inlet.

b. Location. Monroe Lake Dam is located on Bear Swamp Run, a tributary to Marshall Creek, in Middle Smithfield Township, Monroe County, Pennsylvania. The facility is less than five miles north of the community of Marshalls Creek, Pennsylvania and approximately eight miles north of the city of East Stroudsburg, Pennsylvania. The dam, reservoir and watershed are contained within the East Stroudsburg and Skytop, Pennsylvania 7.5 minute U.S.G.S. topographic quadrangles (see Figure 1, Appendix E). The coordinates of the dam are N41° 7.0' and W75° 8.2'.

c. Size Classification. Small (12 feet high, 400 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

4.9

e. <u>Ownership</u>. Monroe Lake Property Owners
Association, Inc.
P.O. Box 17
Marshalls Creek, Pennsylvania 18335
Attn: Leroy F. Hein, Sr.
President

f. <u>Purpose</u>. Recreation.

g. <u>Historical Data</u>. Detailed correspondence from PennDER files indicates that Monroe Lake Dam was originally constructed in 1926 by Clarence Stone of Stroudsburg, Pennsylvania. The facility was designed by J. L. Westbrook, an engineer and surveyor, also of Stroudsburg.

Construction of the original facility was beset with various delays attributable, in part, to the owner's indifference to conforming to state regulations contained within the construction permit. Unannounced design changes and complaints from downstream residents were frequent and completion of the facility was delayed for years. Clarence Stone remained the registered owner of the facility; however, the affairs of the dam were carried out by his associate Dr. W. E. Andrews after 1927.

Sometime around 1947, the still uncompleted and by now deteriorated facility was sold to Stuart P. Pfeiffer of East Stroudsburg, Pennsylvania. In 1948, the state ordered the lake drained by breaching due to the development of hazardous seepage and piping conditions. Mr. Pfeiffer retained the E.C. Hess Company of Stroudsburg, Pennsylvania to design a new facility on the present site (see Figure 2). A construction permit was issued in 1949; but, the owner delayed construction several years such that the permit had to be reissued in 1955. The present facility was finally completed in 1957.

In 1958, the renovated facility was acquired by Pocono Lakeshores, Inc., a Florida based real estate developer. The present community surrounding Monroe Lake is the result of the efforts of this firm. PennDER records indicate the developers showed little interest in maintaining the dam. During the 1960's Pocono Lakeshores, Inc. slowly divested itself of the dam and surrounding facilities, turning them over to an organized group of community homeowners known as the Monroe Lake Property Owners Association.

The Association has officially owned Monroe Lake Dam since 1968 and PennDER records indicate the group has always attempted to fully comply with state requests. To this end, modifications were made to the spillway to provide support for the cracked right spillway wingwall at the request of the state in early 1968 (see Figure 3). In the fall of 1969, however, seepage and piping were discovered along the downstream embankment toe, approximately

150 feet left of the spillway. The condition prompted state officials to order the facility drained. The E.C. Hess Company investigated the condition and, in 1970 and 1971, an extensive, and apparently successful grouting program was conducted and completed.

The facility has functioned without major problems since 1971. The last time significant maintenance was performed on the facility occurred in 1972 when the control gate on the outlet conduit was replaced.

1.3 Pertinent Data.

a. Drainage Area (square miles). 1.1

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Spillway at Maximum Pool ≅ 470 cfs (see Appendix D, Sheet 15).

c. Elevations (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements based on the elevation of normal pool at 992.0 feet as indicated in Figure 1 (see Appendix D, Sheet 1).

Top of Dam	996.0 (design). 994.3 (field).
Maximum Design Pool	Not known.
Maximum Pool of Record	Not known.
Normal Pool	992.0 (assumed datum).
Spillway Crest	992.0
Upstream Inlet Invert	981.5 (design).
Downstream Outlet Invert	981.0 (design). 982.0 (field).
Streambed at Dam Centerline	982.0 (estimated).
Maximum Tailwater	Not known.

d. Reservoir Length (feet)

Top of Dam	2800
Normal Pool	2600

e. Storage (acre-feet).

Top of Dam	403
Normal Pool	184

f. Reservoir Surface (acres).

Top of Dam	105
Normal Pool	85

g. Dam.

Type	Earth.
Length	340 feet (excluding spillway).
Height	12 feet (field measured; embankment crest to downstream embankment toe).
Top Width	Varies; 7 feet minimum, 31 feet maximum.
Upstream Slope	Varies; 3H:1V minimum, 2H:1V maximum.
Downstream Slope	Varies; 3H:1V minimum, 1H:2V maximum.
Zoning (original dam)	Earth upstream slope; partial clay core; rock downstream slope (see Figure 4).
Impervious Core	Partial clay core in original dam.
Cutoff	Impervious clay cutoff reportedly placed along upstream embankment toe of renovated dam (see Figure 2).
Grout Curtain	Remedial grouting performed in 1970-71 to curtail seepage.

h. Diversion Canal and Regulating Tunnels. None.

i. Spillway.

Type	Uncontrolled, rectangular shaped, concrete channel with an ogee-like weir.

Crest Elevation	992.0 feet.
Crest Length	50 feet.

j. Outlet Conduit.

Type	18-inch diameter cast iron pipe.
Length	50 feet.
Closure and Regulating Facilities	Manually controlled upstream of embankment centerline via 18-inch diameter sluice gate located at the inlet. Gate housed at the base of the reinforced concrete riser situated along the upstream embankment face. Additional provisions for flow control are also contained within the riser via stop logs.
Access	The riser is accessible by foot from the embankment crest.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No formal design reports or calcualtions are available. Information pertaining to the design of the original and present facilities is contained in PennDER files in the form of three drawings dated 1927, 1954 and 1968 (see Figures 2, 3, and 4). In addition, these files contain the state construction permit application reports, dated 1925 and 1955, which contain brief descriptions of the design aspects of the original and renovated facilities.

b. Design Features.

1. Embankment. Details of the basic embankment design are presented in Figures 2 and 4. As indicated, the present facility was constructed atop the original earth embankment (see Figure 4). Specific design features are obscured since much of the embankment, as viewed by the inspection team, differed in dimension and cross-section from that shown in Figure 2. The renovated embankment, constructed in 1957, was designed with 2H:1V upstream and downstream slopes and a 10-foot minimum embankment crest width. The embankment crest observed by the inspection team varied in width from seven feet near the left spillway wingwall to 31 feet just left of the outlet conduit and then to 18 feet near the left abutment. Both of the embankment faces are irregular. The upstream slope varies from 2H:1V to 3H:1V and the downstream slope from 1H:2V to 3H:1V. The steepest downstream embankment slope coincides with the broadest section of the embankment crest about 100 feet left of the spillway. A partial clay core along the embankment centerline and an impervious clay cutoff along the upstream embankment toe are apparent in the available drawings and are discussed in state permit reports. Little information is available, however, concerning the embankment foundation. The foundation is known to have been extensively grouted in 1970-71 in an effort to reduce substantial seepage.

2. Appurtenant Structures.

a) Spillway. Design features of the spillway are presented in Figures 2 and 3. As indicated, the spillway is an uncontrolled, rectangular shaped, concrete channel with an ogee-like weir located at the right abutment. The length of the spillway crest is 50 feet. The structure is tied into the embankment on both sides with 18-inch thick concrete key walls that reportedly are carried to impervious foundation material. The spillway was designed to discharge into a rock lined, trapezoidal shaped channel extending to the original streambed, a distance of about 130 feet. However, subsequent to completion of the project in 1957, an access road was constructed along the downstram embankment toe. Discharges from the spillway are now routed through a 5-foot diameter

concrete culvert beneath the road embankment. The upstream portion of the spillway right wingwall, was buttressed by a concrete wall in 1968 as shown in Figure 3.

b) Outlet Conduit. Design features of the outlet conduit are presented in Figure 2. As indicated, the outlet conduit is an 18-inch diameter cast iron pipe with the inlet located at the base of a reinforced concrete riser, and the outlet at the downstream embankment toe. The concrete riser is situated on the upstream side of the embankment, approximately 95 feet to the left of the spillway. Figure 2 depicts the conduit as being totally encased in concrete; whereas, correspondence contained in PennDER files indicates merely that the conduit is placed on a concrete cradle. Flow through the outlet is controlled by means of an 18-inch diameter sluice gate located at the inlet. The gate is manually operated from atop the riser structure. Additionally, the riser contains an operable set of wooden stop logs which are also used to regulate drawdown.

c. Specific Design Data and Criteria. Available design data is limited primarily to the information contained in the 1925 and 1955 state permit application reports and provided on Figures 2 and 4. No information relative to specific design procedures or techniques utilized was obtained.

2.2 Construction Records.

No formal construction records are available for the original facility built in 1926, or for the present facility built in 1955. PennDER files contain photographs and correspondence accumulated during the years of construction; however, there is no information pertaining to specific construction aspects or techniques such as compaction procedures.

2.3 Operational Records.

No records of the day-to-day operation of this facility are available.

2.4 Other Investigations.

Formal state inspection reports are contained in PennDER files for the years 1928, 1929, 1931, 1935, 1938, 1965 and 1969.

No formal engineering reports are available; however, some miscellaneous data pertaining to the grouting program performed in 1970-71 is reportedly contained within the files of RKR Hess Associates, Inc. (formerly the E.C. Hess Company) of Stroudsburg, Pennsylvania.

2.5 Evaluation.

The available data, coupled with the information obtained during the visual inspection, are considered adequate to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests it to be in fair condition.

b. Embankment. Observations made during the visual inspection indicate the embankment is in fair condition. The structure is characterized as very irregular and poorly aligned both horizontally and vertically ~~(see Photographs 1, 2~~, 3, and 4). The downstream embankment toe is partially inundated by water that may be attributable to seepage through the embankment and/or leakage through or around the conduit (see Photographs 2, 3 and 7). The water is trapped in a trough area between the embankments of the dam and the downstream roadway. The condition may be exaggerated because the drainage culvert under the road appears to be partially obstructed ~~(see Photograph 8)~~. Minor erosion was observed along both the upstream and downstream dam faces. Although particularly evident along the upstream slope adjacent the outlet riser and along the steepest portions of the downstream slope, the erosion is not considered to be significant at this time ~~(see Photographs 2, 3 and 4)~~. Field measurements indicate low areas along the embankment crest between one-half and two feet below the elevation of the left spillway wingwall. The crest is covered with gravel and the slopes with weedlike vegetation.

c. Appurtenant Structures.

1. Spillway. The condition of the spillway is considered to be fair. Minor concrete deterioration was observed to be occurring over most of the structure. Spalling and cracking was evident in the right wingwall (see Photograph 12) while horizontal and vertical cracking could be seen along much of the weir. The roadway culvert immediately downstream of the weir appears to potentially impose a restriction to unimpeded spillway flow by constricting the channel.

2. Outlet Conduit. The outlet conduit was operated briefly in the presence of the inspection team and was found to be functional. The discharge end of the conduit at the downstream embankment toe is completely inundated and was not observed (see Photograph 7). The valve control mechanism appears adequately maintained; however, the wooden entry door to the interior of the riser is deteriorating and should be replaced. The stop logs within the tower are deteriorated and, although they function only as a means of regulating pool levels when the sluice gate is fully open, they should be replaced.

d. Reservoir Area. The general area surrounding the reservoir is characterized by steep slopes that are heavily wooded. The hillsides adjacent the lake are heavily developed with numerous permanent and seasonal dwellings (see Figure 1, Appendix E).

e. Downstream Channel. Discharges from Monroe Lake Dam are channeled into Bear Swamp Run which flows south through a steep, narrow valley with steep and heavily forested confining slopes. Approximately 6000 feet downstream, Bear Swamp Run converges with Marshall Creek. Marshall Creek also flows in a southerly direction parallel to a local township road that leads to the community of Marshalls Creek, Pennsylvania about five miles downstream of Monroe Lake Dam. At least 10 or 12 homes are located along the banks of Marshall Creek within several feet of the streambed. It is estimated that approximately 40 to 50 persons could be affected and substantial property damage incurred in the event of an embankment breach. Consequently, the hazard classification is considered to be high.

3.2 Evaluation.

The overall condition of the facility is considered to be fair. The visual inspection revealed several deficiencies requiring remedial attention. Efforts should be made to clear the culvert beneath the roadway at the downstream embankment toe and to allow the water to drain from around the outlet conduit. Subsequently, the location and rates of any seepage and/or leakage should be evaluated. The grade of the entire embankment crest should be raised to conform with the level of the top of the right spillway wingwall (assumed design crest elevation 996.0 feet). Cracking and spalling associated with the spillway concrete should be repaired. The entry door and stop logs associated with the outlet riser should be replaced.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

The facility is essentially self-regulating. That is, excess inflow discharges automatically over the spillway and is directed downstream. Typically, the outlet conduit is closed; however, it was demonstrated to the inspection team that the closure device (sluice gate) is operable. No formal operations manual is available.

4.2 Maintenance of Dam.

No formal maintenance program exists at this facility. The Monroe Lake Property Owners Association, Inc. performs whatever maintenance is necessary based primarily on the recommendations of state inspectors. The Association keeps the facility in a somewhat orderly conditon by cutting excess vegetation along the crest and removing debris from the slopes when necessary. No formal maintenance manual is available.

4.3 Maintenance of Operating Facilities.

No regular maintenance is reportedly performed on the outlet conduit or its operating equipment.

4.4 Warning System.

No formal warning system is presently in effect.

4.5 Evaluation.

No formal operations or maintenance manuals are available for the facility, but, are recommended to ensure proper future care and operation. In addition, a formal warning system should be developed and incorporated into any such manuals.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports or calculations are available. A state construction permit application report, dated 1955, indicates the spillway was designed with a discharge capacity of about 1400 cfs based on a spillway opening 50 feet long and four feet deep (as-built), using 3.5 as the coefficient of discharge. The design capacity exceeded 1955 state requirements and was subsequently approved.

5.2 Experience Data.

Daily records of rainfall and/or spillway discharges are not available.

5.3 Visual Observations.

On the date of the inspection, conditions were observed that could potentially hamper the spillway from functioning as designed. Specifically, the culvert beneath the road downstream of the spillway is insufficiently sized to pass maximum expected spillway flows. In addition, the elevation of the top of the road above the culvert was field measured as being higher than the elevation of the spillway crest. Thus, high tailwater conditions will be created and the discharge efficiency of the spillway will be reduced accordingly as the weir is inundated (see Appendix D, Sheets 8 through 14).

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U.S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U.S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Monroe Lake Dam ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based

on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (high). Due to the high potential for damage to downstream structures and possible loss of life, the SDF for this facility is the PMF.

b. Results of Analysis. Monroe Lake Dam was evaluated under normal operating conditions. That is, the reservoir was initally at its normal pool or spillway elevation of 992.0 feet, with the spillway weir discharging freely. The outlet conduit was assumed to be nonfunctional for the purpose of analysis, since the flow capacity of the conduit is not such that it would significantly increase the total discharge capabilities of the dam and reservoir. The spillway consists of an uncontrolled, rectangular-shaped concrete channel with an ogee-like weir. The effects of expected tailwater resulting from the backup of water behind the culvert and roadway embankment immediately downstream from the dam were taken into account in the spillway rating curve. All pertinent engineering calculations relative to the evaluation of Monroe Lake Dam are provided in Appendix D.

Overtopping analysis (using the modified HEC-1 computer program) indicated that the discharge/storage capacity of Monroe Lake Dam can accommodate only about 30 percent of the PMF (SDF) prior to embankment overtopping. Under PMF conditions, the dam was inundated for about 8.5 hours by depths of up to 1.7 feet. For the 1/2 PMF event, the dam was overtopped for about 5.5 hours, with a maximum depth of about 0.7 feet (Appendix D, Summary Input/Output Sheets, Sheet E). Since the SDF for Monroe Lake Dam is the PMF, it can be concluded that the dam has a high potential for overtopping, and thus, for breaching under floods of less than SDF magnitude. It must be noted that if the embankment crest was regraded and restored to its design elevation, the facility would pass and/or store more than 60 percent of the PMF.

As Monroe Lake Dam cannot safely accommodate floods of at least 1/2 PMF magnitude, the possibility of embankment failure under floods of less than 1/2 PMF intensity was investigated (in accordance with Corps directive ETL-1110-2-234). Several possible alternatives were investigated since it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. The major concern of the breaching analysis is with the impact of the various breach discharges on increasing downstream water surface elevations above those to be expected if breaching did not occur.

The modified HEC-1 computer program was used for the breaching analysis with the assumption that the breaching of an earth dam would begin once the reservoir level reached the low area in the embankment crest. Also, in routing the outflows downstream, the channel bed was assumed to be initially dry.

Five breach models were analyzed for Monroe Lake Dam. First, two sets of breach geometry were evaluated for each of two failure

times. The two sets of breach sections chosen were considered to be the minimum and maximum probable failure sections. The two failure times (total time for each breach section to reach its final dimensions) under which the two breach sections were investigated were assumed to be a rapid time (0.5 hours) and a prolonged time (4.0 hours), so that a range of this most sensitive variable might be examined. In addition, an average possible set of breach conditions was analyzed, with a failure time of 1.0 hour (Appendix D, Sheet 18).

The peak breach outflows (resulting from 0.35 PMF conditions) ranged from about 1,120 cfs for the minimum section-maximum failure time scheme to about 15,290 cfs for the maximum section-minimum fail time scheme (Appendix D, Sheet 20). The peak outflow resulting from the average breach scheme was about 5,910 cfs, compared to the non-breach 0.35 PMF peak outflow of about 525 cfs (Summary Input/Output Sheets, Sheets E and J).

Three potential centers of damage were investigated in the analysis. At Section 2 (see Figure 1), located about 1.8 miles downstream from Monroe Lake Dam, the peak water surface elevation resulting from the maximum section-minimum fail time scheme was about 6.2 feet above the non-breach level (under 0.35 PMF conditions), and about 2.4 feet above the damage level of the nearby dwellings. The peak water surface elevation resulting from the average breach scheme was about 4.4 feet above the non-breach level, or approximately 0.6 feet above the damage level of the existing residences.

The peak water surface elevations at Section 3, about 3.3 miles downstream from the dam, resulting from the average breach scheme and from the maximum section-minimum fail time scheme were about 6.2 to 8.1 feet, respectively, above the non-breach levels, and approximately 3.7 to 5.6 feet, respectively, above the damage levels of the residences.

The third potential damage center is located at Section 4, about 4.0 miles downstream from Monroe Lake Dam. At this section, the increases in the peak water levels resulting from the two above mentioned failure schemes were approximately 3.9 feet and 4.8 feet, respectively, above the non-breach level. These levels were, then, about 3.1 and 4.0 feet, respectively, above the damage levels of the existing residences.

The consequences of dam failure can better be envisioned if not only the increase in the height of the floodwave is considered, but, also the great increase in the momentum of the larger and probably swifter moving volume of water. Therefore, the failure of Monroe Lake Dam would most likely lead to increased property damage and possibly loss of life in the downstream regions.

5.6 Spillway Adequacy.

As presented previously, Monroe Lake Dam can accommodate only about 30 percent of the PMF prior to embankment overtopping. Should a 0.35 PMF or larger event occur, the dam would be overtopped and could possibly fail, endangering downstream residences and increasing the potential for loss of life in the downstream regions. Therefore, the spillway is considered to be seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. The embankment is considered to be in fair structural condition. Many of the deficiencies associated with the embankment can be attributed to its lack of uniformity, which makes routine maintenance difficult, and its unusual downstream toe configuration which is conducive to water ponding at the toe. The source of the presently ponded water along the downstream embankment toe should be ascertained and monitored in future inspections. The excessive settlement along the embankment crest increases the potential for overtopping and subsequent failure by reducing available freeboard and providing areas where erosive flows will be concentrated. Low areas along the embankment crest should be filled and brought up to uniform grade level with the top of the right spillway wingwall at elevation 996.0 feet.

b. Appurtenant Structures.

1. Spillway. The condition of the spillway is considered to be fair. Cracking and spalling observed to be occurring over most of the concrete surfaces of the structure should be repaired while the deterioration is still not very extensive. In order for the spillway to function at full capacity, the roadway downstream of the weir requires modification to eliminate the potential obstruction to high spillway flows. Calculations indicate that a substantial increase in the discharge capacity of the spillway system could be realized if the currently uneven embankment crest was uniformly regraded to the design top of dam level at elevation 996.0 feet.

2. Outlet Conduit. The outlet conduit is operable and currently considered to be in good condition. The discharge end, which was inundated during the inspection and not observed, should be kept clear of potential obstructions. In addition, the small drainage culvert beneath the road downstream of the outlet must be kept clear in order to allow free drainage and increased visibility of the toe area. The entry door and stop logs associated with the outlet riser structure should be replaced.

6.2 Design and Construction Techniques.

No information is available that details the methods of design and/or construction.

6.3 Past Performance.

Available correspondence indicate that the performance of both the original and renovated facilities has been only fair due to

structural problems which have required substantial remedial work. The existing embankment developed a serious piping problem in the late 1960's and was grouted in 1970-1971. The grouting was apparently successful. Cracking and differential movements were also observed in the spillway right wingwall in 1968 and were subsequently repaired by a concrete buttress wall.

The spillway system has functioned adequately with no records of embankment overtopping.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. As the facility appears sufficiently stable, it is believed that it can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The results of this evaluation indicate the facility is in fair condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and possible loss of life, the SDF is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store approximately 30 percent of the PMF prior to embankment overtopping at the low area in the embankment crest. Breach analysis indicates that failure under a 0.35 PMF event or larger could lead to increased downstream damage and potential for loss of life. Thus, based on screening criteria provided in the recommended guidelines, the spillway is considered to be seriously inadequate and the facility unsafe, non-emergency.

Calculations also indicate that if the embankment crest were uniformly regraded to the design top of dam level at elevation 996.0 feet, the facility could pass and/or store approximately 60 percent of the PMF. Consequently, the facility would be considered inadequate rather than seriously inadequate.

In addition, the spillway capacity could be increased to about 75 percent of the PMF if the downstream roadway were modified to enable unrestricted flow.

b. Adequacy of Information. The available data is considered sufficient to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented immediately.

d. Necessity for Additional Investigations. Additional investigations are considered necessary to further assess the spillway adequacy unless remedial measures are taken to uniformly regrade the embankment to the design top of dam level at elevation 996.0 feet.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Uniformly regrade the embankment crest to the design top of dam level at elevation 996.0 feet under the direction of a

registered professional engineer experienced in the construction of earth dams. If it is desired not to perform the above remedial work, the owner should immediately retain the services of a registered professional engineer experienced in the hydrology and hydraulics of dams to further assess the adequacy of the spillway and prepare alternative recommendations for remedial measures deemed necessary to make the facility hydraulically adequate.

b. Clear all obstructions from the road culvert immediately below the outlet to allow the inundated area along the downstream embankment toe to drain and, subsequently, locate the source(s) of any seepage and/or leakage. Furthermore, any seepage and/or leakage observed should be assessed in all future inspections noting any turbidity or changes in rate of flow.

c. Repair the deteriorated concrete associated with the spillway weir and wingwalls.

d. Replace the deteriorated entry door and wooden stop logs associated with the outlet riser.

e. Develop formal manuals of operation and maintenance to ensure the proper future care of the facility. Included in these manuals should be a formal warning system to notify downstream inhabitants should hazardous embankment conditions develop. The system should include provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Monroe Lake Dam STATE Pennsylvania COUNTY Pike

NDI # PA — 00633 PENNDER # 45-117

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High

DATE(S) INSPECTION 20 October 1980 WEATHER Partly Cloudy TEMPERATURE 45° @ 10:00

POOL ELEVATION AT TIME OF INSPECTION 991.7 feet M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
B.M. Mihalcin	Monroe Lake Property Owner's Association, Inc.	
D.L. Bonk	Duane E. Marsh	
D.J. Spaeder		

RECORDED BY B.M. Mihalcin

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00633
SURFACE CRACKS	None observed. Embankment is very irregular and partially covered with gravel, patches of grass and weedlike vegetation.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed. Unpaved access road parallels the downstream embankment toe forming a small trough between the road and the downstream embankment face.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion observed along both the upstream and downstream embankment faces - not significant.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - poor. Embankment is slightly curved inward toward the lake. Vertical - Low areas observed in excess of 1-foot below the top of the right spillway wingwall (see Appendix A, "Profile of Dam Crest").
RIPRAP FAILURES	None observed. Riprap is composed of well graded, hand placed, sandstone boulders. Appears adequate.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00633
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Swampy conditions observed in trough area between access road and downstream embankment face. The water in this area could be attributed to embankment seepage and/or leakage through the outlet. Poor drainage undoubtedly compounds the condition.
ANY NOTICEABLE SEEPAGE	No seepage observed through the downstream embankment face. Water evident in trough area indicates considerable seepage along embankment toe or leakage through or around the outlet conduit. Source is presently inundated and cannot be located. Drainage culvert under roadway is partially obstructed.
STAFF GAGE AND RECORDER	None.
DRAINS	None observed.
MISCELLANEOUS	Embankment is very irregular, but, massive. Static stability appears adequate.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00633
INTAKE STRUCTURE	Vertical, concrete outlet riser located along the upstream embankment face. Concrete in good condition. Wooden hatch door atop riser needs to be replaced.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Not visible. Downstream end is inundated.
OUTLET STRUCTURE	Only a small portion of the downstream face of the concrete outlet headwall is above water. This visible portion appears to be in good condition.
OUTLET CHANNEL	Discharges into roadway culvert. Culvert is presently clogged by muck and debris although a small amount of flow does manage to pass through it.
GATE(S) AND OPERATIONAL EQUIPMENT	18-inch diameter Rodney Hunt (Type S26 18A) sluice gate located at base of riser is functional and in good condition. Manually controlled from atop the riser. Operated in the presence of the inspection team.
OTHER	Stop log provision also located within outlet riser. A few of the logs appear rotted; however, the device is operable.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00633
TYPE AND CONDITION	Uncontrolled, rectangular shaped, concrete channel with an ogee-like weir. Fair condition. *Minor concrete deterioration observed.*
APPROACH CHANNEL	Concrete lined approach in good condition.
SPILLWAY CHANNEL AND SIDEWALLS	Severe scaling evident along surface of the spillway weir and channel floor. The channel sidewalls, particularly the right sidewall, displays evidence of concrete spalling and structural cracking.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Flow over the spillway is discharged through the downstream road embankment via a 5-foot diameter concrete culvert. The top of the roadway is higher than the spillway crest and will cause high tailwater during heavy spillway discharges.
BRIDGE AND PIERS EMERGENCY GATES	None.

SERVICE SPILLWAY

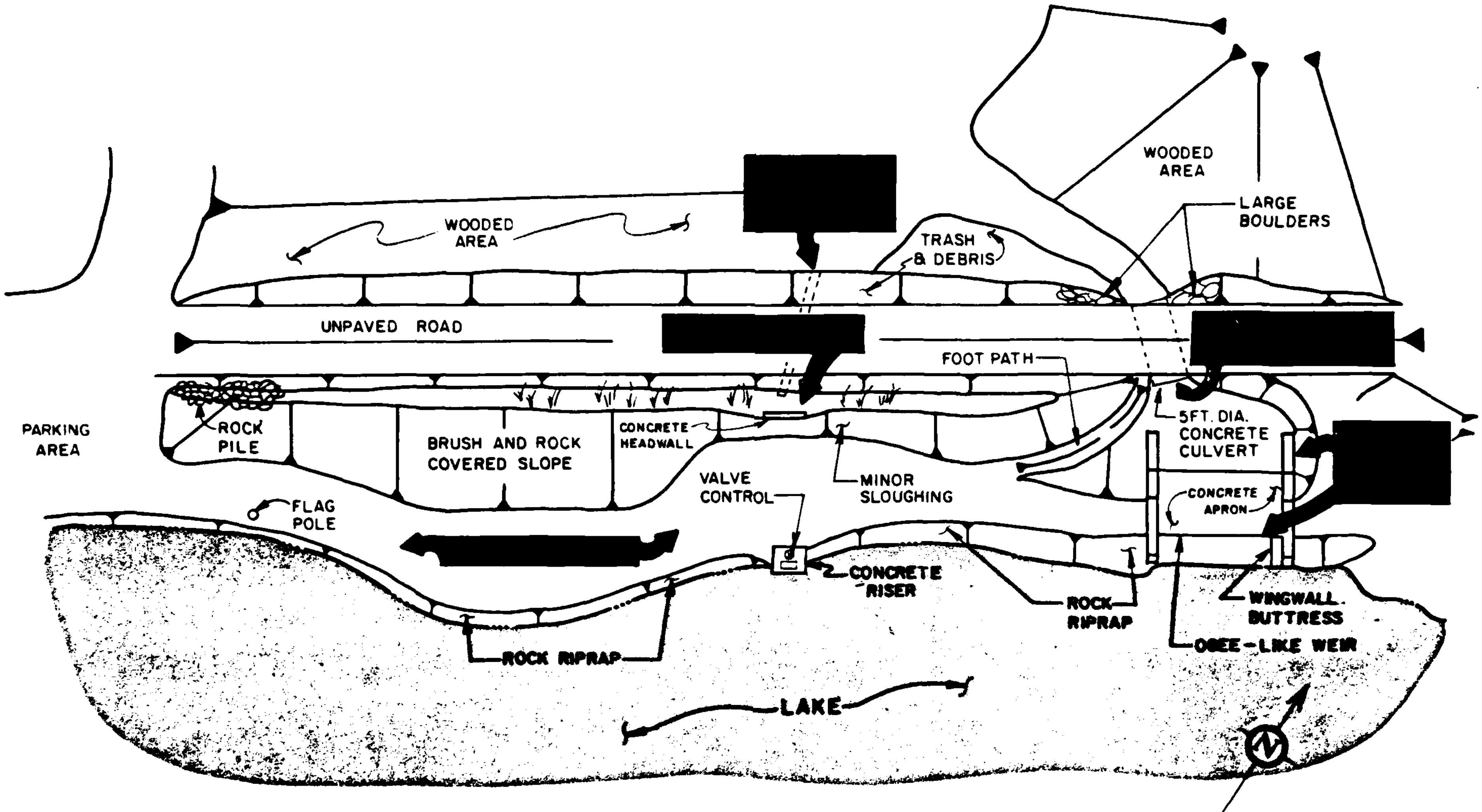
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00633
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

INSTRUMENTATION

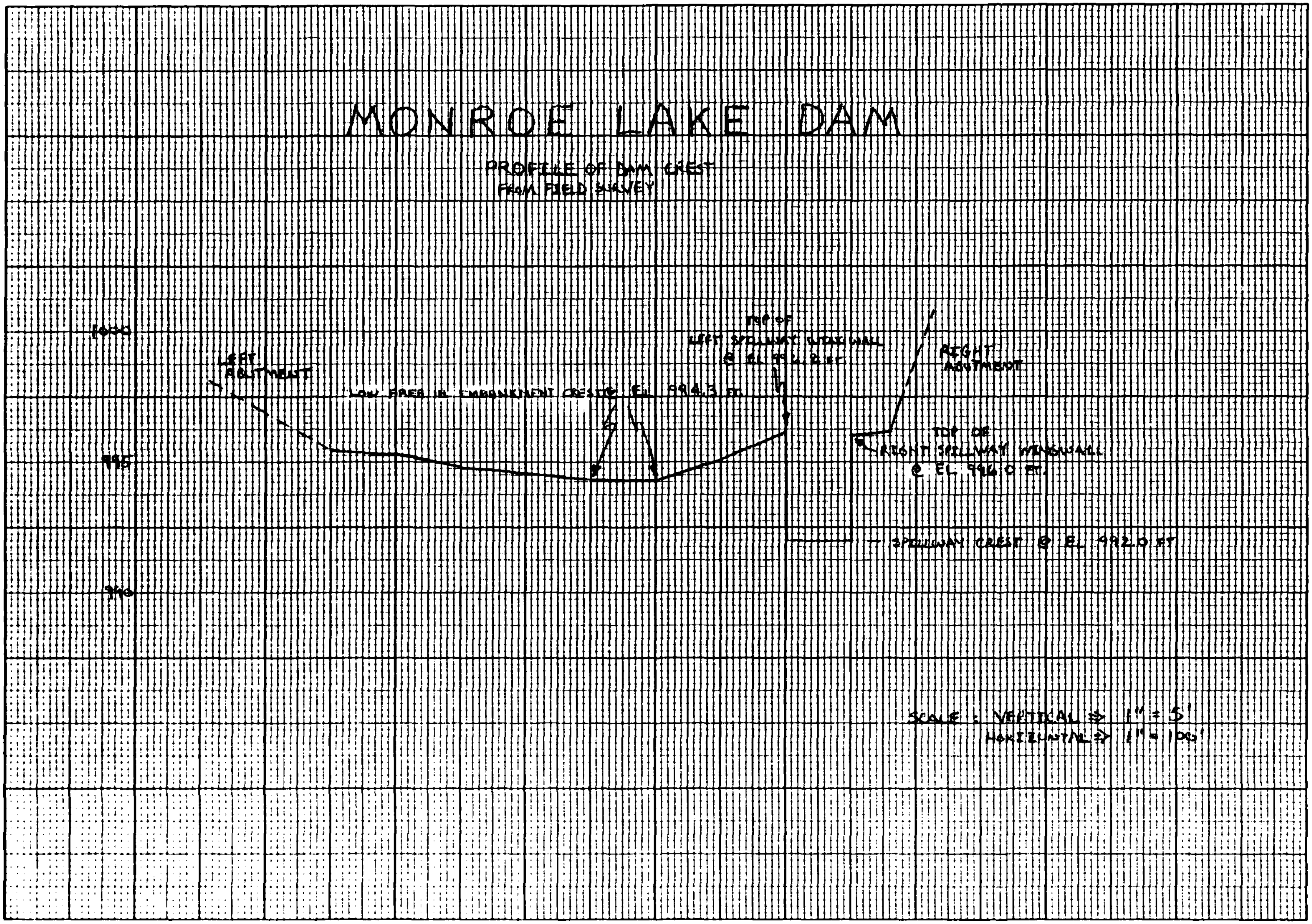
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00633
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	None.

RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00633
SLOPES: RESERVOIR	Moderate to steep, heavily forested slopes.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Discharges from Monroe Lake Dam are channeled in Bear Swamp Run which flows south through a steep, narrow valley with steep and heavily forested confining slopes. It converges about 6,000 feet downstream with Marshall Creek which also flows in a southerly direction parallel to a local township road that leads to the community of Marshalls Creek, Pennsylvania.
SLOPES: CHANNEL VALLEY	Marshall Creek flows through a narrow valley with steep, heavily forested confining slopes. The valley begins to broaden slightly about two miles upstream of the community of Marshalls Creek, Pennsylvania.
APPROXIMATE NUMBER OF HOMES AND POPULATION	At least 10 or 12 homes are located along the banks of Marshall Creek within several feet of the streambed. It is estimated that about 40 to 50 persons could be affected and substantial property damage incurred in the event of an embankment breach.



MONROE LAKE DAM
GENERAL PLAN - FIELD INSPECTION NOTES


MONROE LAKE DAM
PROFILE OF DAM CREST
FROM FIELD SURVEY
1000
995
990
LEFT ABUTMENT
LOW AREA IN EMBANKMENT CREST @ EL. 994.3 FT.
TOP OF
LEFT SPILLWAY WINGWALL
@ EL. 996.2 FT.
RIGHT ABUTMENT
TOP OF
RIGHT SPILLWAY WINGWALL
@ EL. 996.0 FT.
SPILLWAY CREST @ EL. 992.0 FT
SCALE : VERTICAL ⇒ 1" = 5'
HORIZONTAL ⇒ 1" = 100'

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM *Monroe Lake Dam*

ITEM	REMARKS NDI# PA-00633
PERSONS INTERVIEWED AND TITLE	Monroe Lake Property Owners Association, Inc. Leroy F. Hein, Sr. - President Irvin E. Marsh - Board Member Duane E. Marsh - Board Member
REGIONAL VICINITY MAP	See Figure 1, Appendix E.
CONSTRUCTION HISTORY	Original facility constructed in 1926. Breached in 1948. Reconstructed in 1955 and completed in 1957. See Section 1.2.g "Historical Data".
AVAILABLE DRAWINGS	Several drawings of the original and present facilities are contained in PennDER files. Figures 2 and 3, Appendix E, pertain to the present facility. Figure 4 pertains to original dam.
TYPICAL DAM SECTIONS	See Figure 2 and 4, Appendix E.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figure 2, Appendix E. Discharge rating curves are not available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00633
SPILLWAY: PLAN SECTION DETAILS	See Figures 2 and 3, Appendix E.
OPERATING EQUIPMENT PLANS AND DETAILS	See Figure 2, Appendix E. 18-inch diameter sluice gate. Last operated in 1972 prior to its recent operation in the presence of the inspection team.
DESIGN REPORTS	No formal design reports available. RKR Hess Associates, Inc. reportedly has a file for this facility at their office in Stroudsburg, Pennsylvania. However, information contained therein pertains mainly to the grouting performed in 1970-1971.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None available. Design spillway discharge is reported to be 1400 cfs according to information contained in state permit application report dated 1955. Based on a spillway opening 50 feet long and 4 feet deep, with 3.5 used as the discharge coefficient C.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	None available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 00633
BORROW SOURCES	Not known.
POST CONSTRUCTION DAM SURVEYS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Seepage investigation conducted by Hess Associates in 1969. No formal reports available. Correspondence file reportedly available at offices of RKR Hess Associates, Inc., in Stroudsburg, Pennsylvania.
HIGH POOL RECORDS	No formal records available.
MONITORING SYSTEMS	None.
MODIFICATIONS	Constructed between 1955 and 1957. Grouted in 1970-1971.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00633
PRIOR ACCIDENTS OR FAILURES	Original facility was intentionally breached in 1948 upon orders from the state because of serious seepage that had developed. PennDER ordered drawdown of present facility in 1969 citing serious seepage and piping.
MAINTENANCE: RECORDS MANUAL	No records or manual available.
OPERATION: RECORDS MANUAL	No records or manual available.
OPERATIONAL PROCEDURES	Self-regulating. Sluice gate operated to affect drawdown. Functional stop log mechanism is available, but, rarely used.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None.
MISCELLANEOUS	

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CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00633
PENNDER ID # 45-117

SIZE OF DRAINAGE AREA: 1.1 square miles.

ELEVATION TOP NORMAL POOL: 992.0 STORAGE CAPACITY: 184 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 994.3 STORAGE CAPACITY: 403 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 992.0 feet.

TYPE: Uncontrolled, rectangular, concrete channel with ogee-like weir.

CREST LENGTH: 50 feet.

CHANNEL LENGTH: 35 feet; crest to downstream roadway

SPILLOVER LOCATION: Right abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 18-inch diameter cast iron pipe.

LOCATION: Approximate center of embankment.

ENTRANCE INVERTS: 981.5 feet.

EXIT INVERTS: 982.0 feet.

EMERGENCY DRAWDOWN FACILITIES: 18-inch diameter sluice gate at inlet.

HYDROMETEOROLOGICAL GAGES

TYPE: None.

LOCATION: -

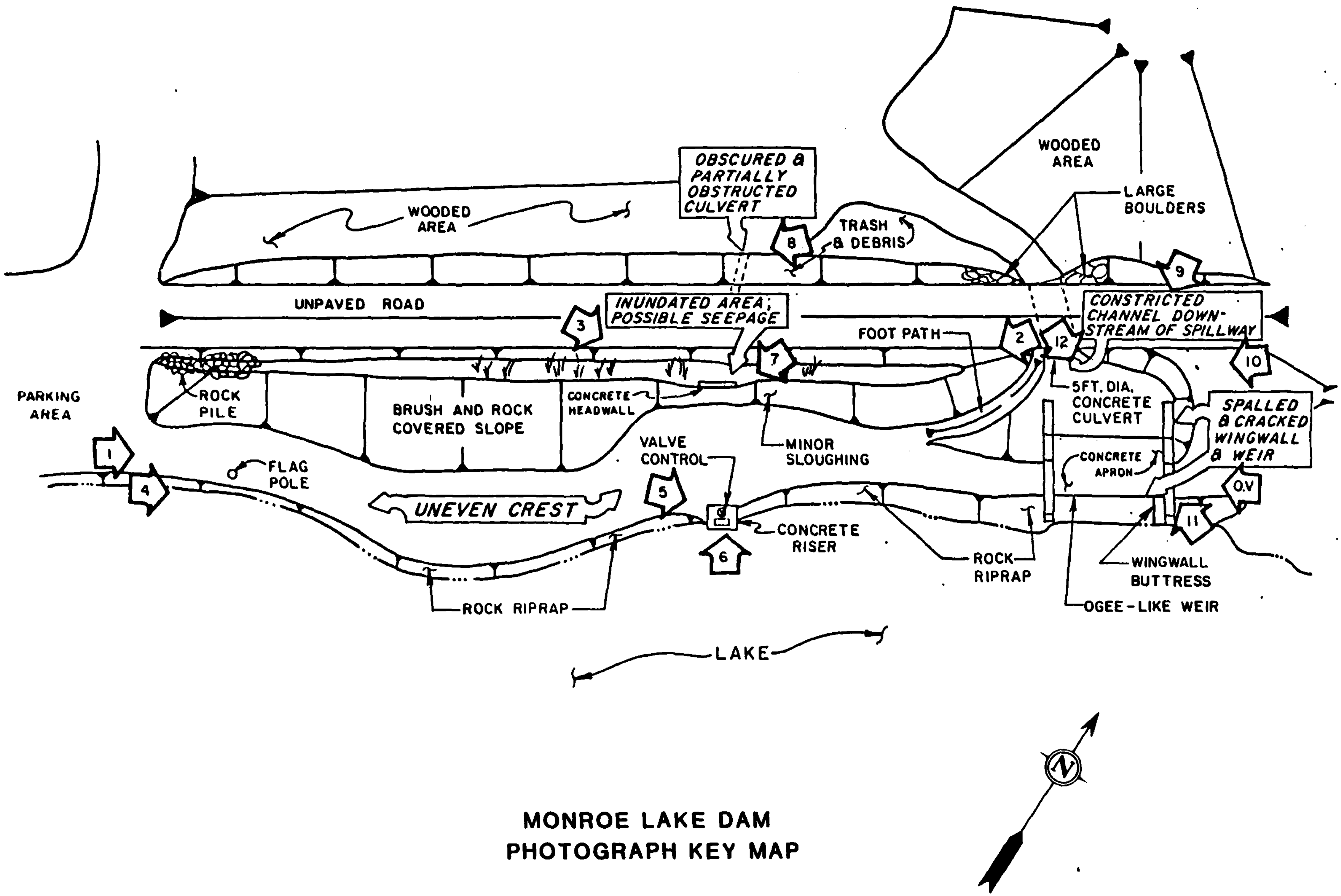
RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

PHOTOGRAPHS

80-238-A10



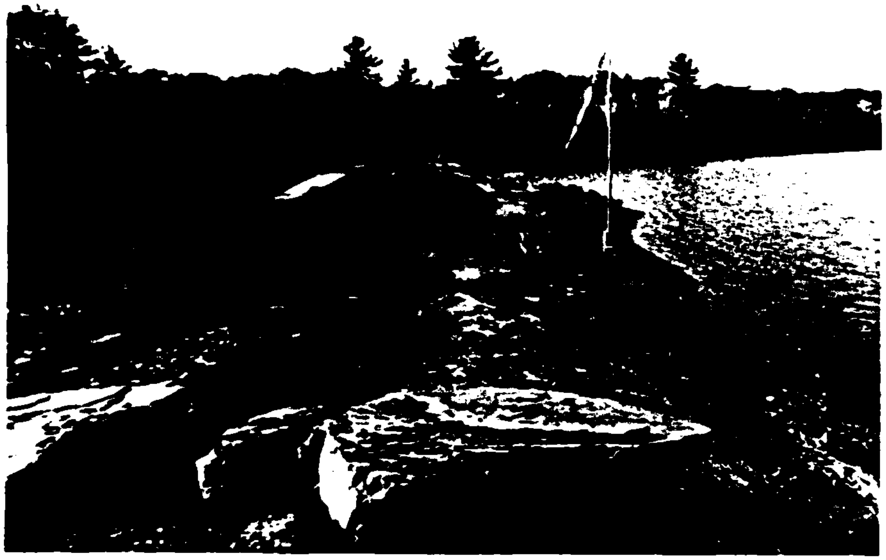
MONROE LAKE DAM
PHOTOGRAPH KEY MAP

Photograph 1 View across the embankment crest looking toward the right abutment.

Photograph 2 View of the downstream embankment face looking toward the left abutment.

Photograph 3 Close-up view of the downstream embankment face in the vicinity of the outlet conduit.

Photograph 4 Close-up view of the upstream embankment face near the left abutment.



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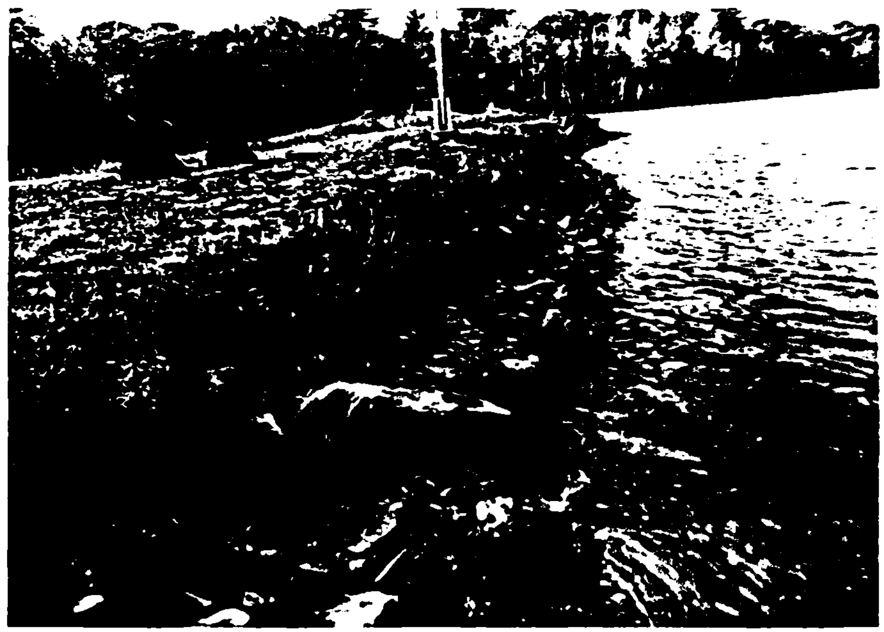

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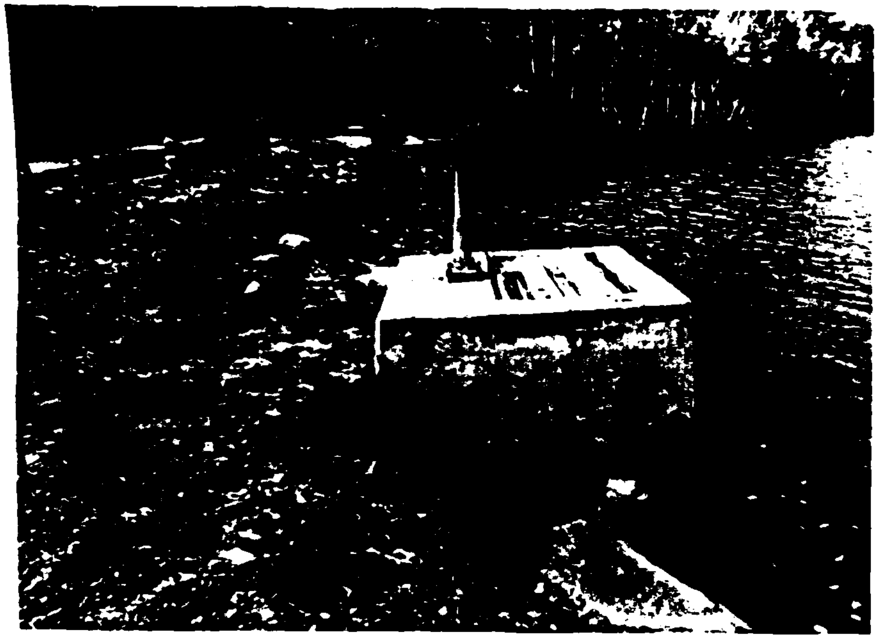
Photograph 5	View of the outlet conduit control mechanism atop the reinforced concrete riser located along the upstream embankment face.
Photograph 6	View of the interior of the outlet riser.
Photograph 7	View of the inundated area along the downstream embankment toe in the vicnity of the outlet conduit.
Photograph 8	View of the debris strewn downstream face of the road embankment opposite the outlet conduit. The culvert beneath the road is obscured and partially obstructed by the debris.



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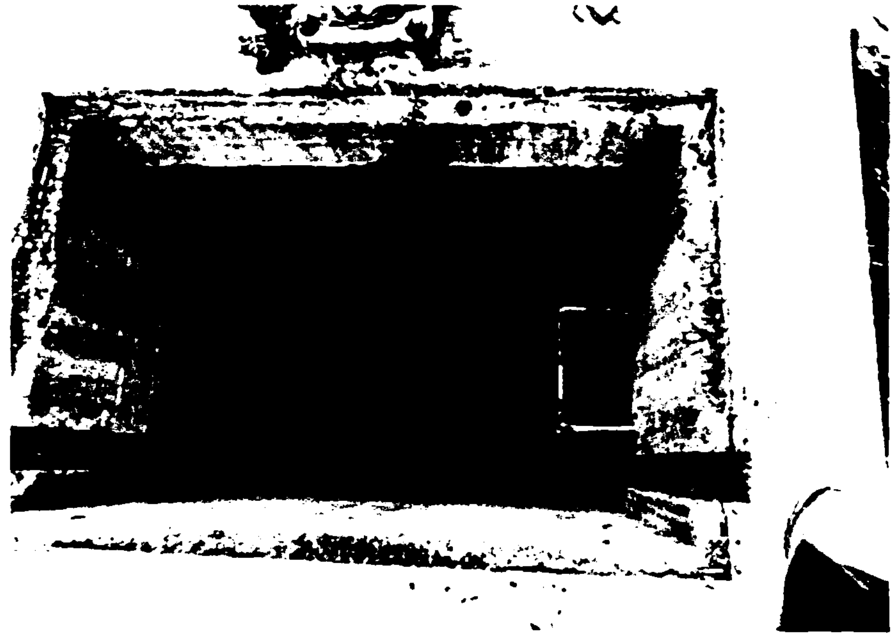

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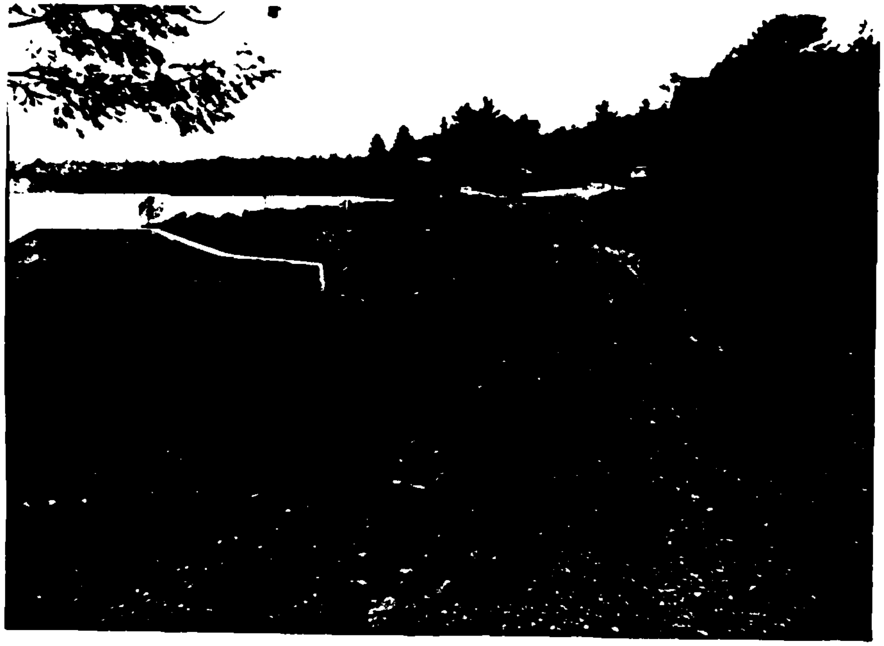
Photograph 9 View of the spillway looking upstream.

Photograph 10 View from the right abutment, looking across the crest of the road downstream of the embankment toward the left abutment.

Photograph 11 View of the 5-foot diameter concrete culvert beneath the road immediately downstream of the spillway.

Photograph 12 View of concrete deterioration observed along the right spillway wingwall.

9



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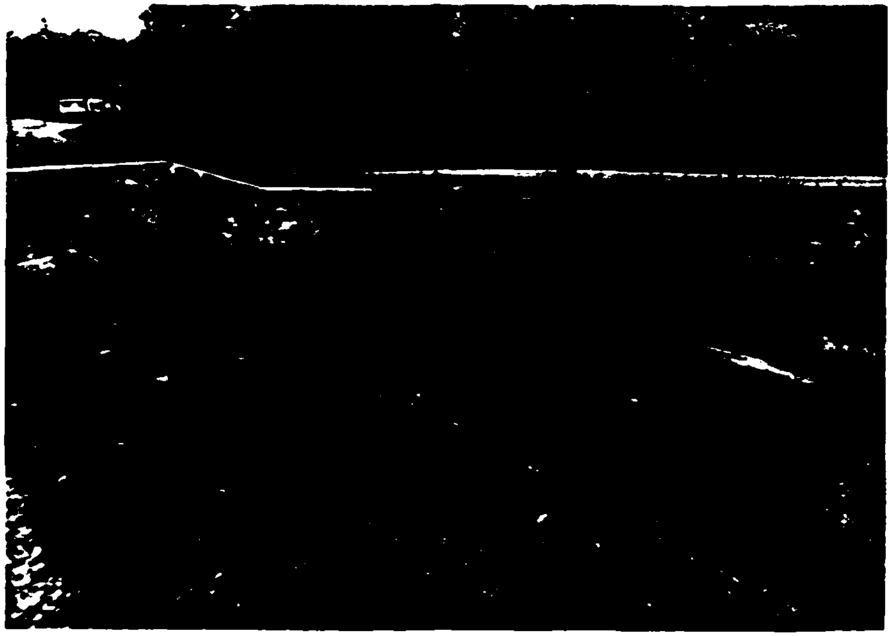

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APPENDIX D

HYDROLOGIC AND HYDRAULIC ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of occurrence the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevation(s) of failure hydrograph(s) for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: MONROE LAKE DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.0 INCHES/24 HOURS (1)

STATION	1	2	3
STATION DESCRIPTION	Monroe Lake Dam		
DRAINAGE AREA (SQUARE MILES)	-		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	1.1		
ADJUSTMENT OF PMF FOR DRAINAGE AREA LOCATION (%) (1)	ZONE 1		
6 HOURS	111		
12 HOURS	123		
24 HOURS	133		
48 HOURS	142		
72 HOURS	-		
SNYDER HYDROGRAPH PARAMETERS			
ZONE (2)	1		
C_p (3)	0.45		
C_t (3)	1.23		
L (MILES) (4)	1.6		
L_{ca} (MILES) (4)	0.6		
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (HOURS)	1.22		
SPILLWAY DATA			
CREST LENGTH (FEET)	50		
FREEBOARD (FEET)	2.3		

(1) HYDROMETEOROLOGICAL REPORT 33, U.S. ARMY CORPS OF ENGINEERS, 1956.
(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYDER COEFFICIENTS (C_p AND C_t).
(3) SNYDER COEFFICIENTS
(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE
L_{ca} = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID.

SUBJECT	DAM SAFETY INSPECTION				
	MONROE LAKE DAM				
BY	DJS	DATE	11-6-80	PROJ. NO.	80-238-633
CHKD. BY	JRL	DATE	12-10-80	SHEET NO.	1 OF 21

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DAM STATISTICS

HEIGHT OF DAM = 12 FT (FIELD MEASURED: TOP OF DAM TO OUTLET INVERT; "TOP OF DAM" HERE AND ON ALL SUBSEQUENT CALCULATION SHEETS REFERS TO THE LOW AREA IN THE EMBANKMENT CREST.)

NORMAL POOL STORAGE CAPACITY ≃ 60 X 10^6 GALLONS
≃ 184 AC-FT (SEE NOTE 1)

MAXIMUM POOL STORAGE CAPACITY = 403 AC-FT (SHEET 4)
(@ TOP OF DAM)

DRAINAGE AREA = 1.1 SQUARE MILES (PLANIMETERED ON USGS 7.5' TOPO QUADS – EAST STROUDSBURG AND SKYTOP PA)

ELEVATIONS:

TOP OF DAM (DESIGN)	≃ 996.0	(SEE NOTE 2)
TOP OF DAM (FIELD)	≃ 994.3	
NORMAL POOL	≃ 992.0	(SEE NOTE 3)
SPILLWAY CREST	≃ 992.0	
UPSTREAM INLET INVERT (DESIGN)	≃ 981.5	(FIG 2, SEE NOTE 3)
DOWNSTREAM OUTLET INVERT (DESIGN)	≃ 981.0	(FIG 2, SEE NOTE 3)
DOWNSTREAM OUTLET INVERT (FIELD)	≃ 982.0	
STREAMBED AT DAM CENTERLINE	≃ NOT KNOWN	

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM
BY DJJ DATE 11-7-80 PROJ. NO. 80-238-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 2 OF 21

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NOTE 1: OBTAINED FROM "REPORT UPON THE APPLICATION OF CLARENCE STONE, FOR THE CONSTRUCTION OF A DAM ACROSS BEAR SWAMP RUN, MIDDLE SMITHFIELD TOWNSHIP, MONROE COUNTY, PENNSYLVANIA," OCTOBER 17, 1925; FOUND IN PENNDER FILES.

NOTE 2: ACCORDING TO "REPORT UPON THE APPLICATION OF STUART P. PFEIFFER, FOR THE RECONSTRUCTION OF A DAM ACROSS BEAR SWAMP RUN, IN MIDDLE SMITHFIELD TOWNSHIP, MONROE COUNTY" (FEBRUARY 28, 1955; FOUND IN PENNDER FILES), THE DESIGN FREEBOARD IS 4 FEET.

NOTE 3: NORMAL POOL ELEVATION IS INDICATED TO BE AT ELEVATION 992 ACCORDING TO USGS TOPO QUAD, EAST STROUDSBURG, PA. ELEVATIONS GIVEN ON DESIGN DRAWINGS ARE ADJUSTED ACCORDINGLY — SPILLWAY CREST DATUM OF 99.0 CORRESPONDS TO 992.0.

DAM CLASSIFICATION

DAM SIZE:	SMALL	(REF 1, TABLE 1)
HAZARD CLASSIFICATION:	HIGH	(FIELD OBSERVATION)
REQUIRED SDF:	½ PMF TO PMF	(REF 1, TABLE 3)

HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE: $L = 1.6$ MILES

LENGTH OF LONGEST WATERCOURSE FROM DAM TO A POINT OPPOSITE BASIN CENTROID: $L_{CA} = 0.6$ MILES

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM
BY DJS DATE 11-7-80 PROJ. NO. 80-238-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 3 OF 21

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$C_t = 1.23$
$C_p = 0.45$

(SUPPLIED BY C.O.E.; ZONE 1, DELAWARE RIVER BASIN)

SNYDER'S STANDARD LAG: $t_p = C_t\,(L \cdot L_{CA})^{0.3}$
$= 1.23\,(1.6 \times 0.6)^{0.3}$
$= \underline{1.22}$ HOURS.

(NOTE: HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REF 2, IN SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH." STREAM LENGTHS WERE MEASURED ON USGS 7.5' TOPO QUADS – EAST STROUDSBURG AND SKYTOP, PA.)

RESERVOIR STORAGE CAPACITY

RESERVOIR SURFACE AREAS:

- SURFACE AREA (S.A.) @ NORMAL POOL (ELEV. 992) = 85 ACRES

(USGS TOPO QUAD - EAST STROUDSBURG, PA)

- S.A. @ ELEV. 1000 = 154 ACRES.

(PLANIMETERED ON USGS TOPO QUADS, EAST STROUDSBURG AND SKYTOP, PA)

- S.A. @ TOP OF DAM (ELEV. 994.3) = 105 ACRES

(BY LINEAR INTERPOLATION)

IT IS ASSUMED THAT THE MODIFIED PRISMOIDAL RELATIONSHIP ADEQUATELY MODELS THE RESERVOIR SURFACE AREA – STORAGE RELATIONSHIP.

$$\Delta V_{1-2} = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 \cdot A_2}\right)$$ (REF 14, p. 15)

WHERE ΔV_{1-2} = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1+2, IN AC-FT,
h = ELEVATION 1 – ELEVATION 2, IN FT,
A_1 = S.A. @ ELEVATION 1, IN ACRES,
A_2 = S.A. @ ELEVATION 2, IN ACRES.

ALSO, IT IS ASSUMED THAT THE SURFACE AREA VARIES LINEARLY BETWEEN ELEVATIONS 992 AND 1000.

ELEVATION – STORAGE RELATIONSHIP:

	ELEVATION (FT)	A_i ① (AC)	ΔV_{1-2} (AC-FT)	TOTAL VOLUME ② (AC-FT)
	982.0 *	0	—	0
(NORMAL POOL)	992.0	85	—	184 **
	993.0	94	89.5	274
	994.0	102	98.0	372
(TOP OF DAM)	994.3	105	31.0	403
	995.0	111	75.6	478
	996.0	120	115.5	594
	997.0	128	124.0	718
	998.0	137	132.5	850
	999.0	145	141.0	991
	1000.0	154	149.5	1141

* ZERO-STORAGE ASSUMED AT ELEVATION 982.0, OR AT THE SAME ELEVATION AS THE OUTLET INVERT.

** FROM SHEET 1

① BY LINEAR INTERPOLATION BETWEEN EL. 992 AND 1000.

② TOTAL VOLUME = $\Sigma \Delta V_{1-2}$.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM
BY DJS DATE 11-17-80 PROJ. NO. 80-338-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 5 OF 21

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PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 22.0 INCHES (CORRESPONDING TO A DURATION OF 24 HOURS AND A DRAINAGE AREA OF 200 SQUARE MILES.)

(REF. 3, FIG. 1)

- DEPTH-AREA-DURATION ZONE 1 (REF. 3, FIG. 1)

- ASSUME DATA CORRESPONDING TO A 10-SQUARE-MILE AREA MAY BE APPLIED TO THIS 1.1 SQUARE-MILE BASIN.

DURATION (HRS)	PERCENT OF INDEX RAINFALL
6	111
12	123
24	133
48	142

(REF 3, FIG. 3)

HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR A DRAINAGE AREA OF 1.1 SQUARE MILES IS 0.80.

(REF 4, p. 48)

EMBANKMENT RATING TABLE

ASSUME THAT THE EMBANKMENT BEHAVES ESSENTIALLY AS A BROAD-CRESTED WEIR WHEN OVERTOPPING OCCURS. THUS, THE DISCHARGE CAN BE ESTIMATED BY THE RELATIONSHIP

$$Q = CLH^{3/2}$$ (REF 5, p. 5-23)

WHERE Q = DISCHARGE OVER EMBANKMENT, IN CFS,
L = LENGTH OF EMBANKMENT OVERTOPPED, IN FT,
H = HEAD, IN FT; IN THIS CASE IT IS THE AVERAGE "FLOW-AREA WEIGHTED" HEAD ABOVE THE CREST,
C = COEFFICIENT OF DISCHARGE.

LENGTH OF EMBANKMENT INUNDATED VS. RESERVOIR ELEVATION:

RESERVOIR ELEVATION (FT)	EMBANKMENT LENGTH (FT)
994.30	0
994.31	50
994.6	120
994.8	180
995.0	215
995.3	260
995.5	280
996.0	315
996.2	360
996.5	365
997.0	380
997.5	395
998.0	405
999.0	435
1000.0	460

(FROM FIELD SURVEY AND USGS TOPO QUAD – EAST STROUDSBURG, PA)

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 11-19-80 PROJ. NO. 80-238-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 7 OF 21

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ASSUME THAT INCREMENTAL DISCHARGES OVER THE EMBANKMENT FOR SUCCESSIVE RESERVOIR ELEVATIONS ARE APPROXIMATELY TRAPEZOIDAL IN CROSS-SECTIONAL FLOW AREA. THEN ANY INCREMENTAL AREA OF FLOW CAN BE ESTIMATED AS $H_i\,[(L_1+L_2)/2]$, WHERE L_1 = LENGTH OF EMBANKMENT OVERTOPPED AT HIGHER ELEVATION, L_2 = LENGTH AT LOWER ELEVATION, H_i = DIFFERENCE IN ELEVATIONS. THUS, THE TOTAL AVERAGE "FLOW-AREA WEIGHTED" HEAD CAN BE ESTIMATED AS H_w = (TOTAL FLOW AREA / L_1).

EMBANKMENT RATING TABLE:

RESERVOIR ELEVATION (FT)	L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	① INCREMENTAL FLOW AREA, A_i (FT²)	TOTAL FLOW AREA, A_T (FT²)	② WEIGHTED HEAD, H_w (FT)	③ H/l	④ C	⑤ Q (CFS)
994.30	0	—	—	—	—	—	—	—	0
994.31	50	0	—	0	0	0	0	—	0
994.6	120	50	0.3	26	26	0.2	0.01	2.97	35
994.8	180	120	0.2	30	56	0.3	0.02	2.99	95
995.0	215	180	0.2	40	96	0.4	0.02	3.01	195
995.3	260	215	0.3	71	167	0.6	0.04	3.03	405
995.5	280	260	0.2	54	221	0.8	0.04	3.03	595
996.0	315	280	0.5	149	370	1.2	0.07	3.04	1220
996.2	360	315	0.2	68	438	1.2	0.07	3.04	1470
996.5	365	360	0.3	109	547	1.5	0.08	3.04	2035
997.0	380	365	0.5	186	733	1.9	0.11	3.04	3095
997.5	395	380	0.5	194	927	2.3	0.13	3.05	4330
998.0	405	395	0.5	200	1127	2.8	0.15	3.05	5735
999.0	435	405	1.0	420	1547	3.6	0.20	3.08	8985
1000.0	460	435	1.0	448	1995	4.3	0.24	3.08	12,795

① $A_i = H_i \left[\frac{(L_1+L_2)}{2}\right]$

② $H_w = A_T / L_1$

③ l = BREADTH OF CREST = 18 FT (AVG. VALUE)

④ $C = f(H_w, l)$; FROM REF 12, FIG. 24.

⑤ $Q = C L_1 H_w^{3/2}$

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJJ DATE 11-18-80 PROJ. NO. 80-238-633

CHKD. BY JRL DATE 12-10-80 SHEET NO. 8 OF 21

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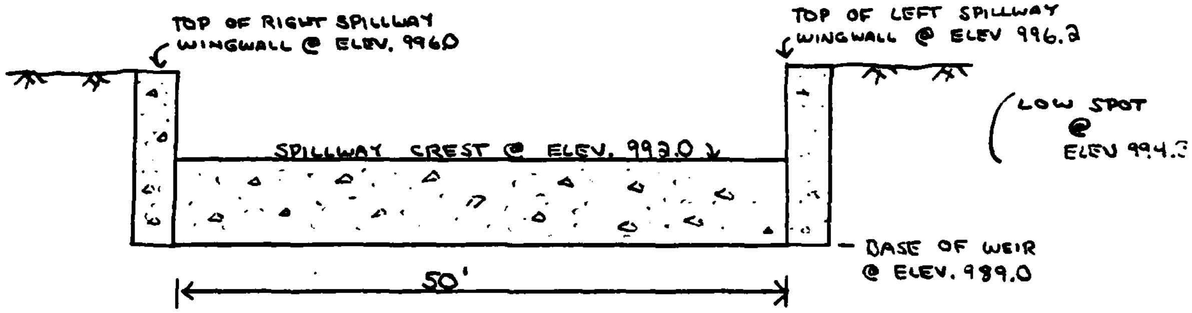
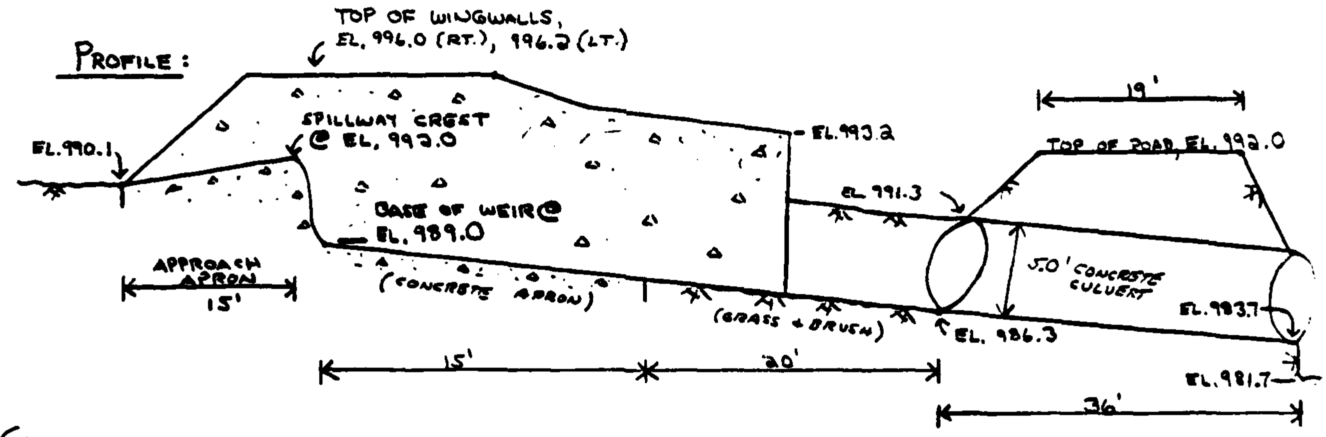
SPILLWAY CAPACITY

CROSS-SECTION: (LOOKING UPSTREAM)



(NOT TO SCALE)

PROFILE:



(SKETCHES BASED ON FIELD MEASUREMENTS AND OBSERVATIONS.)

(NOT TO SCALE)

THE SPILLWAY CONSISTS OF AN UNCONTROLLED, RECTANGULAR-SHAPED CONCRETE CHANNEL WITH A TRIANGULAR-SHAPED, OGEE-LIKE CONCRETE WEIR. THE SPILLWAY DISCHARGE FLOWS THROUGH A 5-FOOT DIAMETER CONCRETE CULVERT UNDER THE ROADWAY IMMEDIATELY DOWNSTREAM OF THE DAM. IN ORDER TO COMPUTE THE DISCHARGE CAPACITY OF THE SPILLWAY, THE CAPACITY OF THE ROADWAY CULVERT MUST FIRST BE COMPUTED.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 11-19-80 PROJ. NO. 80-238-633

CHKD. BY JRL DATE 12-10-80 SHEET NO. 9 OF 21

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CAPACITY OF ROADWAY CULVERT:

IT IS ASSUMED THAT THE DISCHARGE THROUGH THE CULVERT WILL BE DICTATED BY INLET CONTROL. DISCHARGE VALUES FOR VARIOUS HEADWATER DEPTHS ARE TAKEN FROM REF. 19, CHART 2:

	ELEVATION (FT)	HW ① (FT)	HW/D ②	Q ③ (CFS)
	986.3	0.0	0	0
	988.8	2.5	0.50	40
	991.3	5.0	1.00	130
(TOP OF ROADWAY)	992.0	5.7	1.14	160
	992.5	6.2	1.24	180
	993.0	6.7	1.34	190
	993.5	7.2	1.44	210
	994.0	7.7	1.54	220
	994.5	8.2	1.64	240
	995.0	8.7	1.74	250
	995.5	9.2	1.84	260
	996.0	9.7	1.94	270
	997.0	10.7	2.14	300
	998.0	11.7	2.34	320

① HW = HEADWATER = ELEVATION − UPSTREAM INVERT ELEVATION OF CULVERT
= ELEVATION − 986.3

② D = DIAMETER OF CULVERT = 5 FT

③ FROM REF 19, CHART 2 — PROJECTING ENTRANCE TYPE (ROUNDED TO NEAREST 10 CFS) — SEE SHEET 9a.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 11-19-80 PROJ. NO. 80-235-633

CHKD. BY JRL DATE 12-10-80 SHEET NO. 10 OF 21

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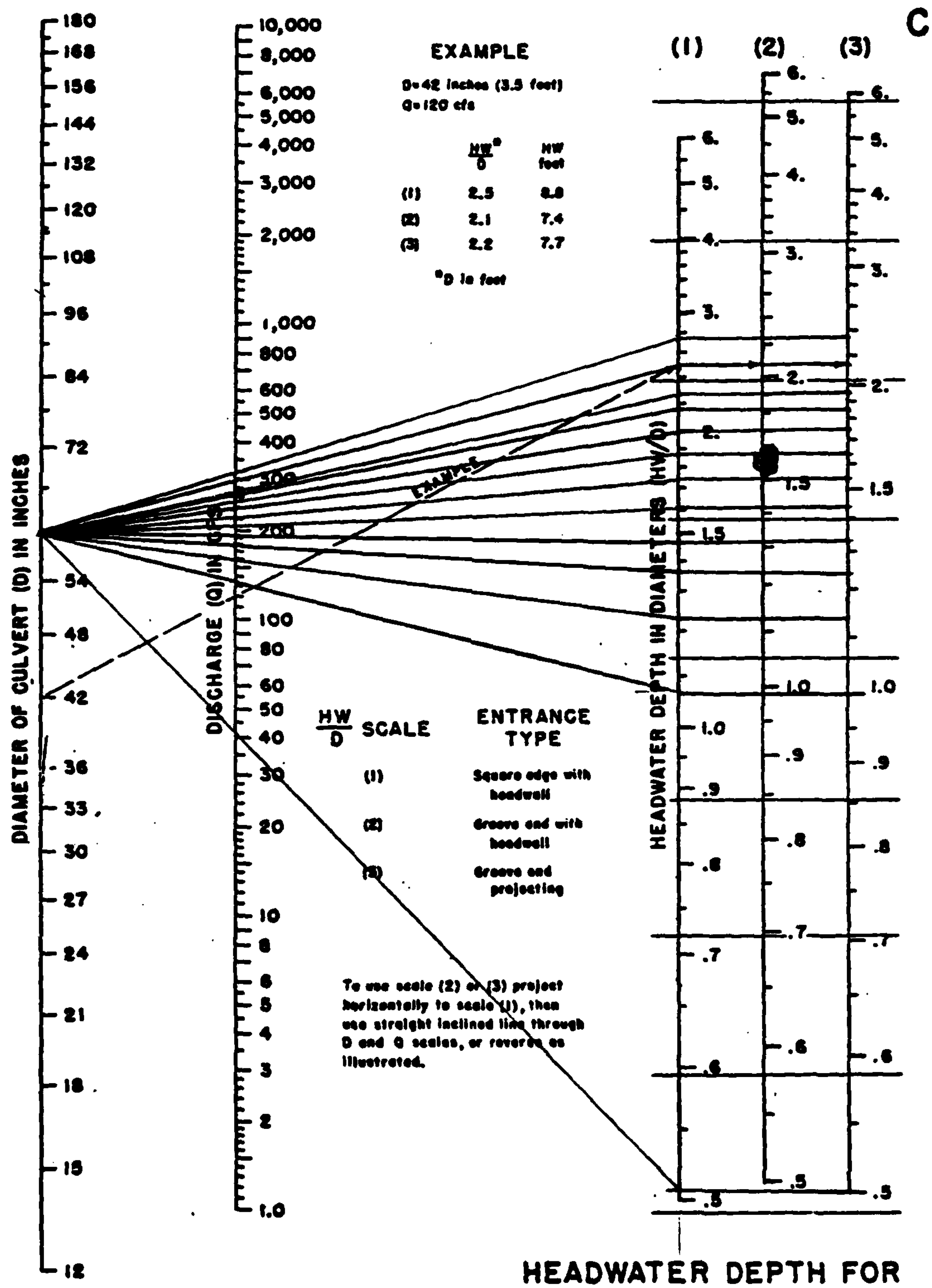
CHART 2

(REF. 19)



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

SUBJECT: DAM SAFETY INSPECTION
MONROE LAKE DAM

BY: DJS DATE: 11-19-80 PROJ. NO. 80-238-633
CHKD. BY: JCL DATE: 12-10-80 SHEET NO. 11 OF 21

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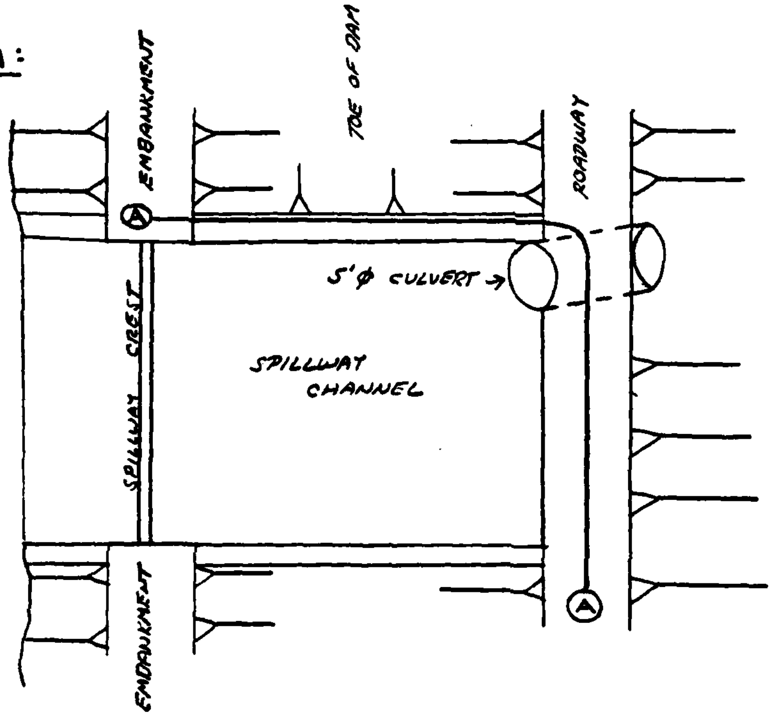
DISCHARGE OVER ROADWAY EMBANKMENT:

PLAN:



(NOT TO SCALE)

AS THE HEADWATER DEPTH RISES OVER THE TOP OF THE CULVERT, WATER WILL DISCHARGE OVER THE ROADWAY AS WELL AS ALONG THE TOE OF THE DAM, THROUGH SECTION A-A, SHOWN ABOVE. IT IS ASSUMED THAT THE OVERTOPPING DISCHARGE CAN BE ESTIMATED BY THE WEIR EQUATION,

$$Q = CLH^{3/2}.$$ (SEE SHEET 6)

THE METHODOLOGY FOR COMPUTING EMBANKMENT DISCHARGES, GIVEN ON SHEETS 6 AND 7, WILL ALSO BE USED HERE.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 11-19-80 PROJ. NO. 80-238-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 12 OF 21

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RATING TABLE: (SECTION A-A)

ELEVATION (FT)	① L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	② INCREMENTAL FLOW AREA, A_i (FT²)	TOTAL FLOW AREA, A_T (FT²)	③ WEIGHTED HEAD, H_w (FT)	④ Q (CFS)
991.30	0	—	—	—	—	—	0
991.31	10	0	0	0	0	0	0
992.0	15	10	0.7	9	9	0.6	20
992.6	25	15	0.6	12	21	0.8	60
993.0	35	25	0.4	12	33	0.9	90
993.2	40	35	0.2	8	41	1.0	120
994.0	70	40	0.8	44	85	1.2	280
994.4	80	70	0.4	30	115	1.4	410
995.0	100	80	0.6	54	169	1.7	680
995.5	115	100	0.5	54	223	1.9	930
996.0	135	115	0.5	63	286	2.1	1270
997.0	135	135	1.0	135	421	3.1	2270
998.0	135	135	1.0	135	556	4.1	3460

① FROM FIELD MEASUREMENTS; ABOVE ELEVATION 996.0 (ELEVATION OF WINGWALLS AND DESIGN TOP OF DAM), THE LENGTH OF OVERTOPPING WILL BE ASSUMED TO BE CONSTANT DUE TO THE OVERTOPPING DISCHARGES OVER THE MAIN EMBANKMENT.

② $A_i = H_i \left[\frac{(L_1 + L_2)}{2} \right]$

③ $H_w = A_T / L_1$

④ $Q = C L_1 H_w^{3/2}$; $C = 3.087$, ASSUMED TO BE CONSTANT (REF 5, p. 5-24).

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 11-19-80 PROJ. NO. 80-228-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 13 OF 21

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TOTAL RATING CURVE FOR CULVERT AND SECTION OF ROADWAY EMBANKMENT IMMEDIATELY DOWNSTREAM OF SPILLWAY:

ELEVATION (FT)	① $Q_{CULVERT}$ (CFS)	② $Q_{OVERTOPPING}$ (CFS)	③ Q_{TOTAL} (CFS)
986.3	0	—	0
988.8	40	—	40
991.3	130	0	130
992.0	160	20	180
992.5	180	50*	230
993.0	190	90	280
993.2	200*	120	320
993.5	210	190*	400
994.0	220	280	500
994.5	240	460*	700
995.0	250	680	930
995.5	260	930	1190
996.0	270	1270	1540
997.0	300	2270	2570
998.0	320	3460	3780

* - BY LINEAR INTERPOLATION FROM RATING TABLE, SHEET 11.
① FROM SHEET 9
② FROM SHEET 11
③ $Q_{TOTAL} = Q_{CULVERT} + Q_{SPILLWAY}$

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM
BY DJS DATE 11-20-80 PROJ. NO. 80-238-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 14 OF 21

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SPILLWAY CAPACITY:

IN ORDER TO COMPUTE THE DISCHARGE CAPACITY OF THE SPILLWAY WEIR, THE EFFECTS OF TAILWATER RESULTING FROM THE DOWNSTREAM ROADWAY EMBANKMENT AND CULVERT MUST BE TAKEN INTO ACCOUNT. IT IS ASSUMED THAT THE RELATIONSHIPS GIVEN IN REF. 4, pp. 376-382, FOR TAILWATER EFFECTS ON OGEE WEIR FLOW, CAN BE APPLIED HERE.

DISCHARGE OVER THE WEIR CAN BE ESTIMATED BY THE EQUATION

$$Q = CLH^{3/2} \qquad \text{(REF 5, p. 5-3)}$$

WHERE
Q = DISCHARGE, IN CFS,
C = COEFFICIENT OF DISCHARGE,
L = LENGTH OF WEIR = 50 FT,
H = HEAD ON WEIR, IN FT.

IT IS ASSUMED THAT THE COEFFICIENT OF DISCHARGE, C, IS ON THE ORDER OF 3.3 (REF 5, TABLE 5-11, TRIANGULAR WEIRS). IT IS ALSO ASSUMED THAT THERE ARE NO SIGNIFICANT APPROACH LOSSES HERE. THE SPILLWAY RATING CURVE IS GIVEN ON SHEET 14.

SUBJECT DAM SAFETY INSPECTION

M[illegible] LAKE DAM

BY DJS DATE 12-8-80 PROJ. NO. 80-238-633

CHKD. BY JRL DATE 12-10-80 SHEET NO. 15 OF 21

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SPILLWAY RATING TABLE:

		INITIAL ITERATION								FINAL ITERATION – TRIAL AND ERROR SOLUTION						
ELEV. (FT)	H (FT)	Q_1 ① (CFS)	TW ELEV ② (FT)	h_d ③ (FT)	$\frac{h_d}{H}$	$\frac{C_s}{C}$ ④	C_2 ⑤	Q_2 ⑥ (CFS)	TW $ELEV_2$ ② (FT)	Q_3 ⑦ (CFS)	TW ELEV ② (FT)	h_d ③ (FT)	$\frac{h_d}{H}$	$\frac{C_s}{C}$ ④	C_3 ⑧	Q_{FINAL} (CFS)
992.0	0	0	—	—	—	—	—	—	—	—	—	—	—	—	—	0
992.5	0.5	58	989.3	3.2	6.40	1.00	3.30	58	989.3	—	—	—	—	—	—	60
993.0	1.0	165	991.8	1.2	1.20	1.00	3.30	165	991.8	—	—	—	—	—	—	165
993.5	1.5	303	993.1	0.4	0.27	0.92	3.04	279	993.0	285	993.0	0.5	0.33	0.95	3.14	290
994.0	2.0	467	993.8	0.2	0.10	0.65	2.15	304	993.1	410	993.6	0.4	0.20	0.86	2.84	400
(TOP OF DAM) 994.3	2.3	576	994.2	0.1	0.04	0.40	1.32	230	992.5	470	993.9	0.4	0.17	0.82	2.71	470
994.5	2.5	652	994.4	0.1	0.04	0.40	1.32	261	992.8	520	994.1	0.4	0.16	0.80	2.64	520
995.0	3.0	857	994.8	0.2	0.07	0.55	1.82	471	993.9	700	994.5	0.5	0.17	0.82	2.71	700
995.5	3.5	1080	995.3	0.2	0.06	0.50	1.65	540	994.1	885	994.9	0.6	0.17	0.82	2.71	885
(DESIGN TOP OF DAM) 996.0	4.0	1320	995.7	0.3	0.08	0.60	1.98	792	994.7	1110	995.3	0.7	0.18	0.84	2.77	1110
996.5	4.5	1575	996.0	0.5	0.11	0.68	2.24	1071	995.3	1325	995.7	0.8	0.18	0.84	2.77	1325
997.0	5.0	1845	996.3	0.7	0.14	0.76	2.51	1402	995.8	1585	996.0	1.0	0.20	0.86	2.84	1585
997.5	5.5	2128	996.6	0.9	0.16	0.80	2.64	1702	996.2	1870	996.3	1.2	0.22	0.88	2.90	1870
998.0	6.0	2425	996.9	1.1	0.18	0.84	2.77	2037	996.5	2160	996.6	1.4	0.23	0.89	2.94	2160

① $Q_1 = CLH^{3/2}$, WHERE $L = 50$ FT; ASSUME C IS ON THE ORDER OF 3.3 (REF 5, TABLE 5-11)

② TAILWATER ELEVATION — LINEARLY INTERPOLATED - SHEET 12

③ h_d = RESERVOIR ELEVATION – TW ELEVATION.

④ FROM FIG. 254, REF 4. (p. 382)

⑤ $C_2 = \frac{C_s}{C} \times 3.3$

⑥ $Q_2 = C_s/C \times Q_1$, OR $C_2LH^{3/2}$

⑦ Q_3 = ESTIMATE OF FINAL OR ACTUAL FLOW

⑧ $C_3 = C_s/C \times 3.3$

⑨ $Q_{FINAL} = C_s/C \times Q_1$, OR $C_3LH^{3/2}$

SUBJECT	DAM SAFETY INSPECTION MONROE LAKE DAM		
BY DJT	DATE 12-9-80	PROJ. NO. 80-238-633	
CHKD. BY JRL	DATE 12-10-80	SHEET NO. 16 OF 21	

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I.) TOTAL FACILITY RATING TABLE: EXISTING CONDITIONS.

	RESERVOIR ELEVATION (FT)	$Q_{SPILLWAY}$ ① (CFS)	$Q_{EMBANKMENT}$ ② (CFS)	Q_{TOTAL} ③ (CFS)
	992.0	0	–	0
	992.5	60	–	60
	993.0	165	–	165
	993.5	290	–	290
	994.0	400	–	400
(TOP OF DAM)	994.3	470	0	470
	994.6	555 *	35	590
	994.8	630 *	95	725
	995.0	700	195	895
	995.3	810 *	405	1215
	995.5	885	595	1480
(DESIGN TOP OF DAM)	996.0	1110	1220	2330
	996.5	1325	2035	3360
	997.0	1585	3095	4680
	997.5	1870	4330	6200
	998.0	2160	5735	7895

① FROM SPILLWAY RATING TABLE, SHEET 14; ROUNDED TO NEAREST 5 CFS.

② FROM SHEET 7.

③ $Q_{TOTAL} = Q_{SPILLWAY} + Q_{EMBANKMENT}$

* – LINEARLY INTERPOLATED FROM SPILLWAY RATING TABLE, SHEET 14; ROUNDED TO NEAREST 5 CFS.

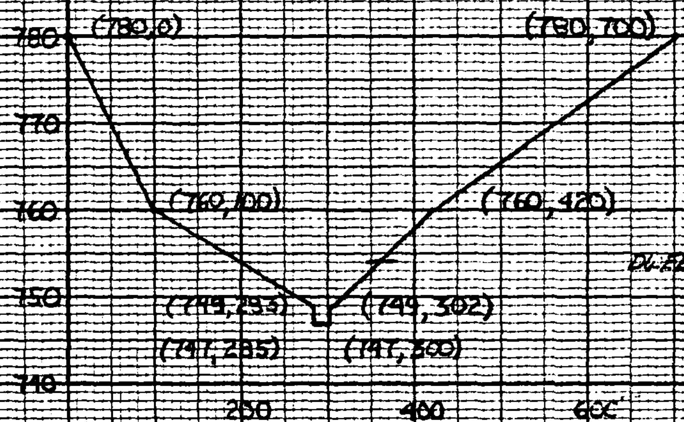
SUBJECT MONROE LAKE DAM
BY DJS DATE 11-21-80 SHEET NO 17 OF 21
CHKD BY JRW DATE 12-19-80 PROJECT NO 80-238-633

DOWNSTREAM ROUTING SECTIONS

SECTION 2.0

≈ 7560 FT D.S. FROM DAM
INVERT = 747.0
CHANNEL SLOPE ≈ 0.019
$n_{LOB} = n_{ROB} = 0.080$
$n_{CH} = 0.050$

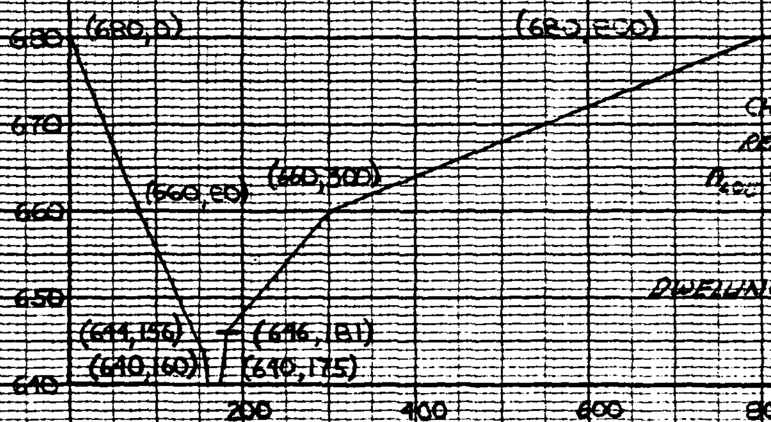
DWELLINGS ≈ 7' ABOVE CHANNEL BED



SECTION 3.0

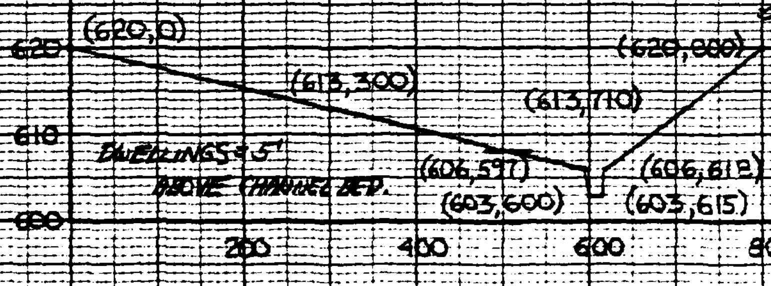
≈ 11,380 FT D.S. FROM DAM
INVERT = 640.0
CHANNEL SLOPE ≈ 0.018
REACH LENGTH ≈ 7820 FT
$n_{LOB} = n_{ROB} = 0.080$
$n_{CH} = 0.050$

DWELLINGS ≈ 6' ABOVE CHANNEL BED



SECTION 4.0

≈ 21,240 FT D.S. FROM DAM
INVERT = 603.0
CHANNEL SLOPE = 0.006
REACH LENGTH = 3860 FT
$n_{LOB} = n_{ROB} = 0.080$
$n_{CH} = 0.045$



(NOTE: SECTIONS BASED ON FIELD NOTES AND OBSERVATIONS AND USGS TOPO QUAD — EAST STROUDSBURG, PA. ELEVATIONS ARE ESTIMATES OFF USGS TOPO QUAD, AND ARE NOT NECESSARILY ACCURATE.)

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 12-10-80 PROJ. NO. 80-238-633

CHKD. BY JRL DATE 12-10-80 SHEET NO. 18 OF 21

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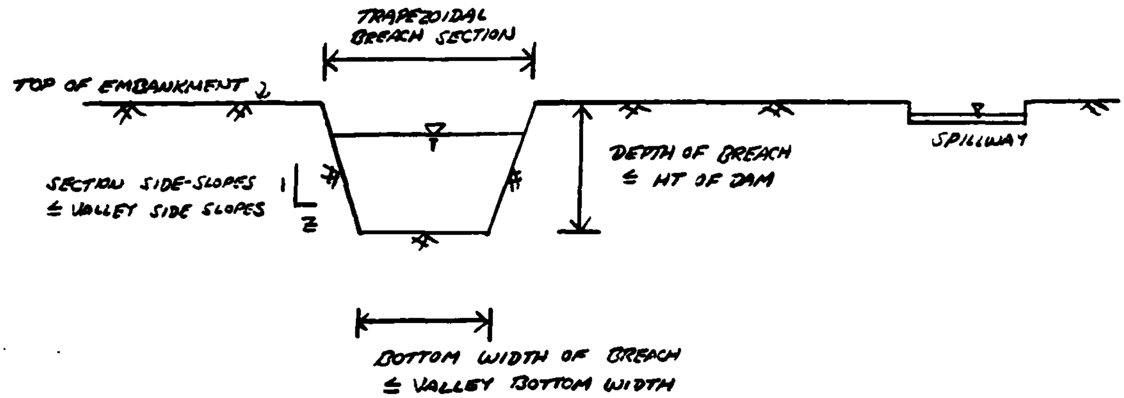
BREACH ASSUMPTIONS

TYPICAL BREACH SECTION:



HEC-1 BREACHING ANALYSIS INPUT:

(ASSUME BREACHING COMMENCES WHEN THE RESERVOIR LEVEL REACHES THE TOP OF DAM ELEVATION: 994.3)

PLAN	BOTTOM WIDTH OF BREACH (FT)	MAX. BREACH DEPTH (FT)	SECTION SIDE-SLOPES	BREACH TIME (HRS)	W.S. EL. AT START OF FAILURE
① MINIMUM BREACH SECTION, MINIMUM FAIL TIME	0	12	1H:1V	0.5	994.3
② MAXIMUM BREACH SECTION, MINIMUM FAIL TIME	250	12	3.5:1	0.5	994.3
③ MINIMUM BREACH SECTION, MAXIMUM FAIL TIME	0	12	1:1	4.0	994.3
④ MAXIMUM BREACH SECTION, MAXIMUM FAIL TIME	250	12	3.5:1	4.0	994.3
⑤ AVERAGE POSSIBLE CONDITIONS	50	12	1:1	1.0	994.3

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 12-10-80 PROJ. NO. 80-238-633
CHKD. BY JRL DATE 12-10-80 SHEET NO. 19 OF 21

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THE BREACH ASSUMPTIONS LISTED ON THE PREVIOUS SHEET ARE BASED ON THE SUGGESTED RANGES PROVIDED BY THE C.O.E. (BALTIMORE DISTRICT) AND ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURROUNDING TERRAIN:

- MAX. DEPTH OF BREACH: HEIGHT OF DAM = 12.3 FT
  (TOE OF DAM TO LOW POINT ON CREST)

- EMBANKMENT CREST LENGTH: 340 FT - TOTAL BREACHABLE EMBANKMENT
  (FIELD MEASURED)

- VALLEY BOTTOM WIDTH: ≈ 250 FT (FIELD OBSERVATION, FIG. 2)

- VALLEY SIDE-SLOPES ADJACENT TO DAM:

  LEFT SIDE: ≈ 4H : 1V
  RIGHT SIDE: ≈ 10H : 1V

(USGS TOPO QUAD - EAST STROUDSBURG, PA)

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 12-11-80 PROJ. NO. 80-238-633

CHKD. BY JRL DATE 12-16-80 SHEET NO. 20 OF 21

GAI CONSULTANTS, INC.
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HEC-1 DAM BREACHING ANALYSIS OUTPUT SUMMARY:

RESERVOIR DATA: (UNDER 0.35 PMF BASE FLOW CONDITIONS)

PLAN NUMBER *	VARIABLE BREACH BOTTOM WIDTH (FT)	ACTUAL MAX. FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF PEAK (HRS)	INTERPOLATED OR HEC-1 ROUTED MAX. FLOW DURING FAIL TIME (CFS)	CORRESPONDING TIME OF PEAK (HRS)	ACTUAL PEAK FLOW THROUGH DAM (CFS)	CORRESPONDING TIME OF PEAK (HRS)	TIME OF INITIAL BREACH (HRS)
1	0	1711	43.50	1711	43.50	1711	43.50	43.00
2	250	15288	43.55	13806	43.50	15288	43.55	43.17
3	0	1119	47.00	1119	47.00	1119	47.00	43.00
4	250	3135	44.67	3135	44.67	3135	44.67	43.17
5	50	5913	44.00	5913	44.00	5913	44.00	43.00

* FROM SHEET 19.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY DJS DATE 12-11-80 PROJ. NO. 80-238-633

CHKD. BY JRL DATE 12-16-80 SHEET NO. 21 OF 21

GAI CONSULTANTS, INC.
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DOWNSTREAM ROUTING DATA: (UNDER 0.35 PMF BASE FLOW CONDITIONS)

PLAN NUMBER	BREACH BOTTOM WIDTH (FT)	PEAK FLOW (CFS)	CORRESPONDING WATER SURFACE ELEVATION (FT) ①	WATER SURFACE ELEVATION W/O BREACH (FT) ②	ELEVATION DIFFERENCE (FT)	APPROXIMATE DAMAGE LEVEL OF DWELLINGS (FT)
OUTPUT @ SECTION 2; 9560 FT D.S. FROM DAM						
1	0	1401	751.9	750.2	+1.7	754
2	250	7716	756.4	750.2	+6.2	
3	0	1040	751.3	750.2	+1.1	
4	250	2776	753.4	750.2	+3.2	
5	50	4366	754.6	750.2	+4.4	
OUTPUT @ SECTION 3; 17380 FT D.S. FROM DAM						
1	0	1378	646.1	643.5	+2.6	646
2	250	6203	651.6	643.5	+8.1	
3	0	1027	645.1	643.5	+1.6	
4	250	2654	648.2	643.5	+4.7	
5	50	3939	649.7	643.5	+6.2	
OUTPUT @ SECTION 4; 21240 FT D.S. FROM DAM						
1	0	1326	608.9	607.2	+1.7	608
2	250	4842	612.0	607.2	+4.8	
3	0	1002	608.4	607.2	+1.2	
4	250	2441	610.3	607.2	+3.1	
5	50	3476	611.1	607.2	+3.9	

① FROM SUMMARY INPUT/OUTPUT SHEETS, SHEET J.

② INTERPOLATED FROM RATING TABLES, SUMMARY INPUT/OUTPUT SHEETS, SHEETS D AND E; BASED ON ESTIMATED 0.35PMF ROUTED OUTFLOW = 525 CFS.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-239-633
CHKD. BY DJS DATE 12-30-80 SHEET NO. A OF J

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SUMMARY INPUT/OUTPUT SHEETS

OVERTOPPING ANALYSIS

DAM SAFETY INSPECTION
MONROE LAKE DAM *** OVERTOPPING ANALYSIS *** EXISTING CONDITIONS
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .10 .20 .30 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RESERVOIR INFLOW COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.10	0.00	1.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

INITIAL AND CONSTANT RAINFALL LOSSES AS PER COE

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.22 CP= .45 NTA= 0

BASE FLOW PARAMETERS AS PER COE

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.79 AND R=11.72 INTERVALS

UNIT HYDROGRAPH 67 END-OF-PERIOD ORDINATES, LAG= 1.22 HOURS, CP= .45 VOL= 1.00

11.	42.	86.	138.	189.	230.	256.	262.	249.	229.
210.	193.	177.	162.	149.	137.	126.	115.	106.	97.
89.	82.	75.	69.	63.	58.	54.	49.	45.	41.
38.	35.	32.	29.	27.	25.	23.	21.	19.	18.
16.	15.	14.	13.	12.	11.	10.	9.	8.	8.
7.	6.	6.	5.	5.	4.	4.	4.	3.	3.
3.	3.	2.	2.	2.	2.	2.			

0
END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.99	22.60	2.39	93327.
										(635.)(	574.)(	61.)(	2642.73)

SUBJECT: DAM SAFETY INSPECTION
MONROE LAKE DAM

BY: WJV DATE: 12-11-80 PROJ. NO. 80-238-633
CHKD. BY: DJS DATE: 12-30-80 SHEET NO. B OF J

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RESERVOIR INFLOW HYDROGRAPHS

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	856.	564.	191.	97.	27967.
CMS	24.	16.	5.	3.	792.
INCHES		4.77	6.45	6.57	6.57
MM		121.23	163.93	166.87	166.87
AC-FT		280.	378.	385.	385.
THOUS CU M		345.	467.	475.	475.

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1427.	941.	318.	162.	46612.
CMS	40.	27.	9.	5.	1320.
INCHES		7.95	10.76	10.95	10.95
MM		202.05	273.27	278.12	278.12
AC-FT		466.	631.	642.	642.
THOUS CU M		575.	778.	792.	792.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2854.	1881.	636.	324.	93225.
CMS	81.	53.	18.	9.	2640.
INCHES		15.91	21.51	21.90	21.90
MM		404.11	546.44	556.24	556.24
AC-FT		933.	1261.	1284.	1284.
THOUS CU M		1151.	1556.	1584.	1584.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	184.	-1

STAGE	992.00	992.50	993.00	993.50	994.00	994.30	994.60	994.80	995.00
	995.50	996.00	996.50	997.00	997.50	998.00			
FLOW	0.00	60.00	165.00	290.00	400.00	470.00	590.00	725.00	895.00
	1480.00	2330.00	3360.00	4680.00	6200.00	7895.00			

CAPACITY=	0.	184.	274.	372.	403.	478.	594.	718.	850.
ELEVATION=	982.	992.	993.	994.	994.	995.	996.	997.	998.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
992.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
994.3	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-239-633

CHKD. BY DJS DATE 12-30-80 SHEET NO. C OF J

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RESERVOIR OUTFLOW HYDROGRAPH

PEAK OUTFLOW IS 410. AT TIME 43.67 HOURS

0.3 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	410.	367.	127.	64.	18532.
CMS	12.	10.	4.	2.	525.
INCHES		3.10	4.30	4.35	4.35
MM		78.81	109.30	110.57	110.57
AC-FT		182.	252.	255.	255.
THOUS CU M		224.	311.	315.	315.

PEAK OUTFLOW IS 869. AT TIME 43.00 HOURS

0.5 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	869.	668.	227.	115.	33073.
CMS	25.	19.	6.	3.	937.
INCHES		5.65	7.69	7.77	7.77
MM		143.44	195.21	197.33	197.33
AC-FT		331.	451.	456.	456.
THOUS CU M		408.	556.	562.	562.

PEAK OUTFLOW IS 2340. AT TIME 42.17 HOURS

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2340.	1643.	525.	265.	76330.
CMS	66.	47.	15.	8.	2161.
INCHES		13.89	17.76	17.93	17.93
MM		352.85	451.18	455.43	455.43
AC-FT		815.	1042.	1051.	1051.
THOUS CU M		1005.	1285.	1297.	1297.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE FROM DAM TO SECTION 2: 9560 FT D.S. FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
102	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0500	.0800	747.0	780.0	9560.	.01900

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 780.00 100.00 760.00 283.00 749.00 285.00 747.00 300.00 747.00
302.00 749.00 420.00 760.00 700.00 780.00

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM
BY WJV DATE 12-11-80 PROJ. NO. 80-238-633
CHKD. BY DJS DATE 12-30-80 SHEET NO. D OF J

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 STORAGE      0.00      6.30     20.13     51.80    101.59    169.49    255.51    359.65    481.16
            763.24    923.14   1095.63   1280.69   1478.33   1688.55   1911.35   2146.73   2394.69

 OUTFLOW      0.00    153.66    592.03   1574.61   3343.37   6101.23  10030.05  15297.73  22277.79
          41485.76  53622.25  67532.48  83284.44 100947.40 120591.22 142285.80 166100.86 192105.72

   STAGE    747.00    748.74    750.47    752.21    753.95    755.68    757.42    759.16    760.89
            764.37    766.11    767.84    769.58    771.32    773.05    774.79    776.53    778.26

    FLOW      0.00    153.66    592.03   1574.61   3343.37   6101.23  10030.05  15297.73  22277.79
          41485.76  53622.25  67532.48  83284.44 100947.40 120591.22 142285.80 166100.86 192105.72


          *********         *********         *********         *********         *********

                              HYDROGRAPH ROUTING

          ROUTE FROM SECTION 2 TO SECTION 3; 17380 FT D.S. FROM DAM

                      ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        203       1       0       0       0       0       1       0       0

                                  ALL PLANS HAVE SAME
                                      ROUTING DATA
              QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                0.0   0.000    0.00       1       1       0       0               0

                      NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                          1       0       0   0.000   0.000   0.000     -1.       0


NORMAL DEPTH CHANNEL ROUTING
----------------------------

          QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
          .0800   .0500   .0800   640.0   680.0   7820.  .01800


          CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
             0.00  680.00   80.00  660.00  156.00  644.00  160.00  640.00  175.00  640.00
           181.00  646.00  300.00  660.00  800.00  680.00

 STORAGE      0.00      6.46     14.54     26.04     45.93     76.37    117.34    168.86    230.93
            388.24    494.47    623.76    776.13    951.58   1150.10   1371.69   1616.36   1884.10

 OUTFLOW      0.00    206.57    678.33   1477.74   2789.44   4757.66   7546.68  11299.57  16147.26
          29039.48  37353.14  47994.93  61154.02  77061.98  95957.74 118077.51 143652.01 172905.51

   STAGE    640.00    642.11    644.21    646.32    648.42    650.53    652.63    654.74    656.84
            661.05    663.16    665.26    667.37    669.47    671.58    673.68    675.79    677.89

    FLOW      0.00    206.57    678.33   1477.74   2789.44   4757.66   7546.68  11299.57  16147.26
          29039.48  37353.14  47994.93  61154.02  77061.98  95957.74 118077.51 143652.01 172905.51
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SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-238-633

CHKD. BY DJS DATE 12-30-80 SHEET NO. E OF J

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********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE FROM SECTION 3 TO SECTION 4; 21240 FT D.S. FROM DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
304	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.009	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0450	.0800	603.0	620.0	3860.	.00600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 620.00 300.00 613.00 597.00 606.00 600.00 603.00 615.00 603.00
618.00 606.00 710.00 613.00 800.00 620.00

STORAGE	0.00	1.26	2.66	4.21	6.69	12.87	23.00	37.08	55.09
	102.94	132.78	166.57	204.31	246.00	291.64	341.24	394.78	452.28
OUTFLOW	0.00	31.73	100.87	199.72	344.32	584.35	967.80	1536.52	2327.23
	4706.61	6356.15	8349.54	10714.66	13477.83	16664.32	20298.64	24404.66	29005.63
STAGE	603.00	603.89	604.79	605.68	606.58	607.47	608.37	609.26	610.16
	611.95	612.84	613.74	614.63	615.53	616.42	617.32	618.21	619.11
FLOW	0.00	31.73	100.87	199.72	344.32	584.35	967.80	1536.52	2327.23
	4706.61	6356.15	8349.54	10714.66	13477.83	16664.32	20298.64	24404.66	29005.63

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	992.00	992.00	994.30
STORAGE	184.	184.	403.
OUTFLOW	0.	0.	470.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	992.79	0.00	255.	121.	0.00	43.83	0.00
.20	993.43	0.00	316.	272.	0.00	43.67	0.00
.30	994.04	0.00	376.	410.	0.00	43.67	0.00
.50	994.97	.67	475.	869.	5.50	43.00	0.00
1.00	996.00	1.70	595.	2340.	8.50	42.17	0.00

OVERTOPPING
OCCURS
@
0.3 PMF

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-238-633

CHKD. BY DJS DATE 12-30-80 SHEET NO. F OF J

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BREACHING ANALYSIS

INPUT DATA IS THE SAME AS FOR THE OVERTOPPING ANALYSIS WITH THE ADDITION OF THE BREACH DATA GIVEN HERE

```
DAM SAFETY INSPECTION
MONROE LAKE DAM *** BREACHING ANALYSIS *** EXISTING CONDITIONS
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

                         JOB SPECIFICATION
  NO    NHR   NMIN   IDAY    IHR   IMIN  METRC   IPLT   IPRT  NSTAN
 288      0     10      0      0      0      0      0      0      0
                      JOPER    NWT  LROPT  TRACE
                          5      0      0      0

                  MULTI-PLAN ANALYSES TO BE PERFORMED
                     NPLAN= 5 NRTIO= 1 LRTIO= 1
 RTIOS=   .35

**********     **********     **********     **********     **********

                         HYDROGRAPH ROUTING

 ROUTE THROUGH RESERVOIR
```

PLAN

```
                                   DAM DATA
                         TOPEL    COOD    EXPD   DAMWID
                         994.3     0.0     0.0       0.
```

①

```
                                DAM BREACH DATA
              BRWID       Z    ELBM   TFAIL    WSEL  FAILEL
                 0.    1.00  982.00     .50  992.00  994.30

                       STATION    101, PLAN 1, RATIO 1

BEGIN DAM FAILURE AT 43.00 HOURS
PEAK OUTFLOW IS      1711. AT TIME  43.50 HOURS
```

②

```
                                DAM BREACH DATA
              BRWID       Z    ELBM   TFAIL    WSEL  FAILEL
               250.    3.50  982.00     .50  992.00  994.30

                       STATION    101, PLAN 2, RATIO 1

BEGIN DAM FAILURE AT 43.17 HOURS
PEAK OUTFLOW IS     15288. AT TIME  43.55 HOURS
```

SUBJECT: DAM SAFETY INSPECTION
MONROE LAKE DAM

BY: WJV DATE: 12-11-80 PROJ. NO.: 80-238-633

CHKD. BY: DJS DATE: 12-30-80 SHEET NO.: G OF J

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PLAN

③

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
0.	1.00	982.00	4.00	992.00	994.30

STATION 101, PLAN 3, RATIO 1

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 1119. AT TIME 47.00 HOURS

④

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
250.	3.50	982.00	4.00	992.00	994.30

STATION 101, PLAN 4, RATIO 1

BEGIN DAM FAILURE AT 43.17 HOURS

PEAK OUTFLOW IS 3135. AT TIME 44.67 HOURS

⑤

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
50.	1.00	982.00	1.00	992.00	994.30

STATION 101, PLAN 5, RATIO 1

BEGIN DAM FAILURE AT 43.00 HOURS

PEAK OUTFLOW IS 5913. AT TIME 44.00 HOURS

SUBJECT DAM SAFETY INSPECTION

MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-238-633

CHKD. BY DJS DATE 12-30-80 SHEET NO. H OF J

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THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

PLAN 5

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS) -	COMPUTED BREACH HYDROGRAPH (CFS) =	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
43.000	0.000	470.	470.	0.	0.	0.
43.021	.021	528.	491.	37.	37.	0.
43.042	.042	586.	529.	56.	93.	0.
43.063	.063	644.	578.	65.	158.	0.
43.083	.083	701.	636.	66.	224.	0.
43.104	.104	759.	701.	59.	283.	0.
43.125	.125	817.	772.	45.	328.	1.
43.146	.146	875.	850.	25.	353.	1.
43.167	.167	933.	933.	-0.	353.	1.
43.188	.188	1035.	1021.	14.	367.	1.
43.208	.208	1138.	1114.	23.	390.	1.
43.229	.229	1240.	1211.	29.	419.	1.
43.250	.250	1342.	1312.	30.	449.	1.
43.271	.271	1444.	1417.	27.	476.	1.
43.292	.292	1547.	1525.	21.	497.	1.
43.313	.313	1649.	1637.	12.	509.	1.
43.333	.333	1751.	1751.	0.	509.	1.
43.354	.354	1876.	1868.	7.	517.	1.
43.375	.375	2001.	1988.	12.	529.	1.
43.396	.396	2125.	2110.	15.	544.	1.
43.417	.417	2250.	2234.	15.	560.	1.
43.438	.437	2374.	2360.	14.	573.	1.
43.458	.458	2499.	2488.	11.	584.	1.
43.479	.479	2624.	2618.	5.	589.	1.
43.500	.500	2748.	2748.	0.	589.	1.
43.521	.521	2882.	2879.	3.	592.	1.
43.542	.542	3016.	3012.	5.	597.	1.
43.563	.562	3151.	3145.	5.	602.	1.
43.583	.583	3285.	3279.	5.	608.	1.
43.604	.604	3419.	3414.	5.	612.	1.
43.625	.625	3553.	3550.	4.	616.	1.
43.646	.646	3687.	3685.	2.	618.	1.
43.667	.667	3821.	3821.	0.	618.	1.
43.688	.687	3956.	3958.	-2.	616.	1.
43.708	.708	4090.	4092.	-3.	613.	1.
43.729	.729	4224.	4227.	-3.	610.	1.
43.750	.750	4358.	4361.	-3.	607.	1.
43.771	.771	4492.	4495.	-3.	604.	1.
43.792	.792	4626.	4629.	-2.	602.	1.
43.813	.812	4761.	4762.	-1.	601.	1.
43.833	.833	4895.	4895.	-0.	601.	1.
43.854	.854	5022.	5024.	-2.	598.	1.
43.875	.875	5149.	5151.	-2.	597.	1.
43.896	.896	5277.	5277.	-0.	596.	1.
43.917	.917	5404.	5402.	2.	598.	1.
43.938	.937	5531.	5526.	5.	603.	1.
43.958	.958	5658.	5652.	6.	610.	1.
43.979	.979	5786.	5783.	2.	612.	1.
44.000	1.000	5913.	5913.	0.	612.	1.

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-238-633

CHKD. BY DSS DATE 12-30-80 SHEET NO. I OF J

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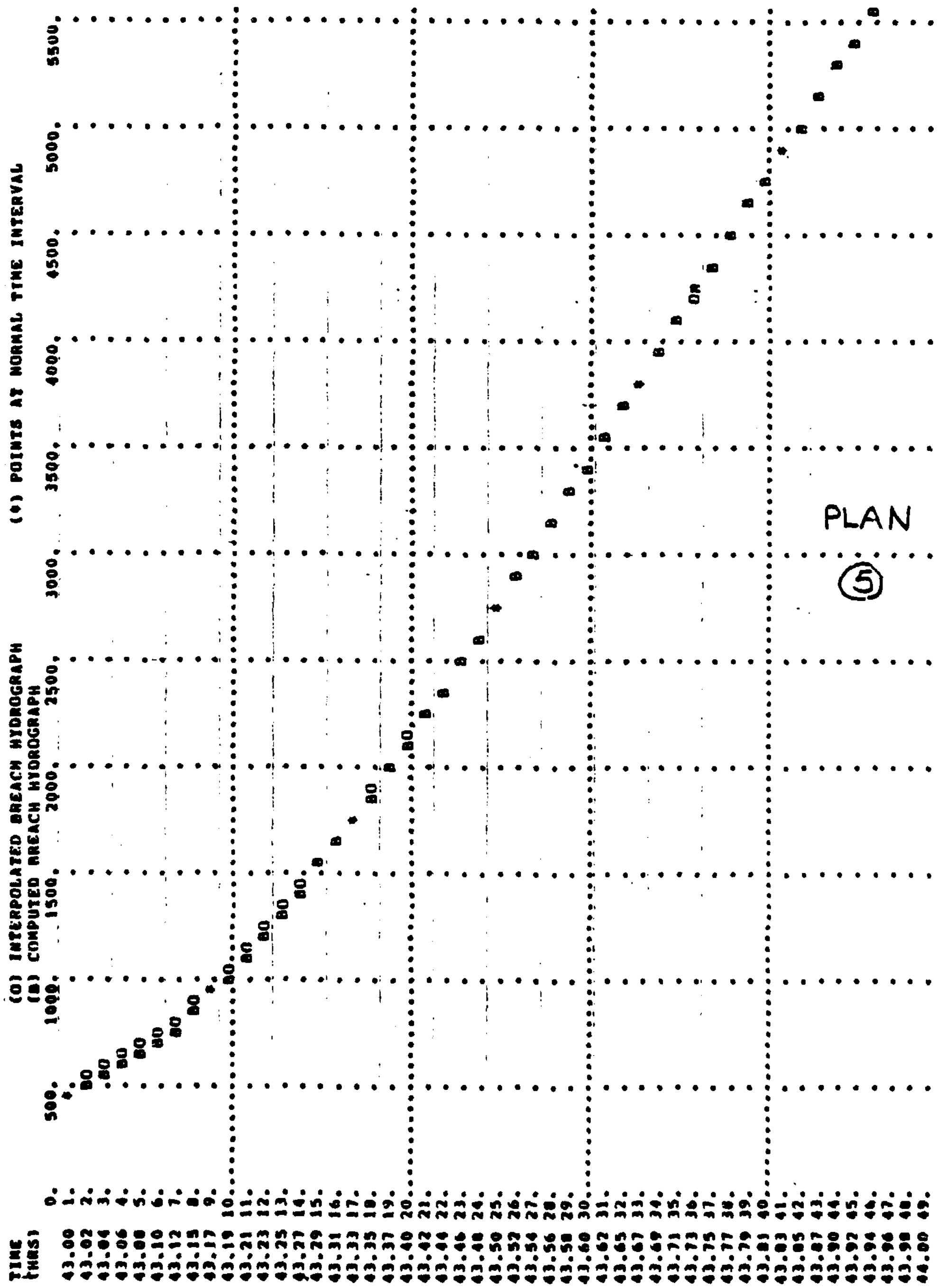

SUBJECT DAM SAFETY INSPECTION
MONROE LAKE DAM

BY WJV DATE 12-11-80 PROJ. NO. 80-238-633
CHKD. BY DJS DATE 12-30-80 SHEET NO. J OF J

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SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	992.00	992.00	994.30
STORAGE	184.	184.	403.
OUTFLOW	0.	0.	470.

PLAN	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1	.35	994.31	.01	405.	1711.	.47	43.50	43.00
2	.35	994.32	.02	405.	15288.	.22	43.55	43.17
3	.35	994.33	.03	406.	1119.	1.25	47.00	43.00
4	.35	994.32	.02	405.	3135.	.33	44.67	43.17
5	.35	994.31	.01	404.	5913.	.29	44.00	43.00

SECTION 2
@ ≈ 9560 FT
DS FROM DAM

STATION 102

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.35	1401.	751.9	44.17
.35	7716.	756.4	43.67
.35	1040.	751.3	47.17
.35	2776.	753.4	44.67
.35	4366.	754.6	44.17

STATION 203

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.35	1378.	646.1	44.50
2	.35	6201.	651.6	43.83
3	.35	1027.	645.1	47.33
4	.35	2654.	648.2	44.83
5	.35	3939.	649.7	44.33

SECTION 3
@ ≈ 17380 FT
DS FROM DAM

STATION 304

PLAN	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1	.35	1326.	608.9	44.83
2	.35	4892.	612.0	44.00
3	.35	1002.	608.4	47.67
4	.35	2441.	610.3	45.00
5	.35	3476.	611.1	44.50

SECTION 4
@ ≈ 21240 FT
DS FROM DAM

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13. <u>Applied Hydraulics in Engineering</u>, H. M. Morris and J. N. Wiggert, Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

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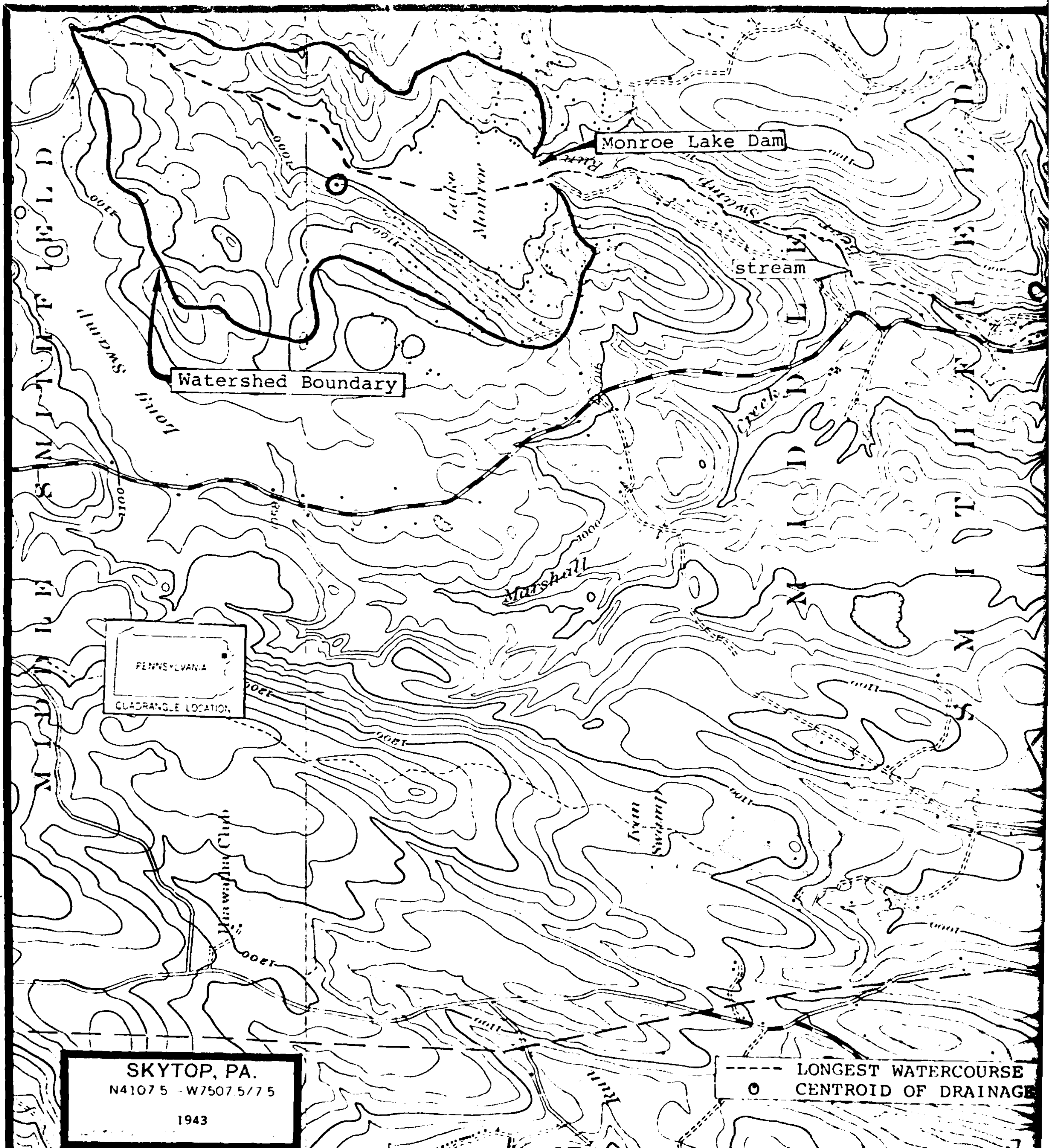
APPENDIX E

FIGURES

LIST OF FIGURES



Monroe Lake Dam
Lake Monroe
stream
Watershed Boundary
Pond Swamp
Creek
Marshall
PENNSYLVANIA
QUADRANGLE LOCATION
Hiawatha Club
SKYTOP, PA.
N4107.5 -W7507.5/7.5
1943
LONGEST WATERCOURSE
CENTROID OF DRAINAG

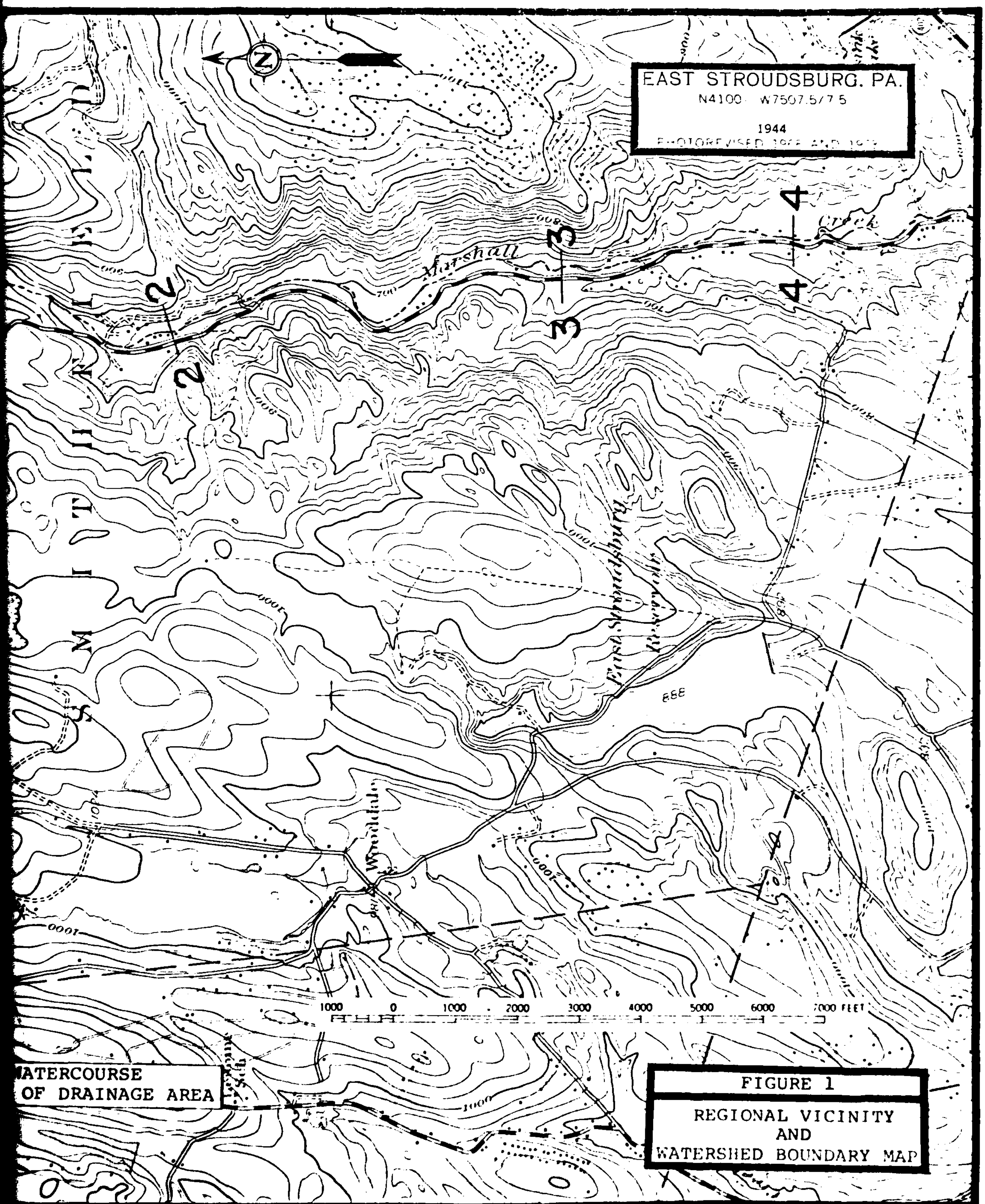
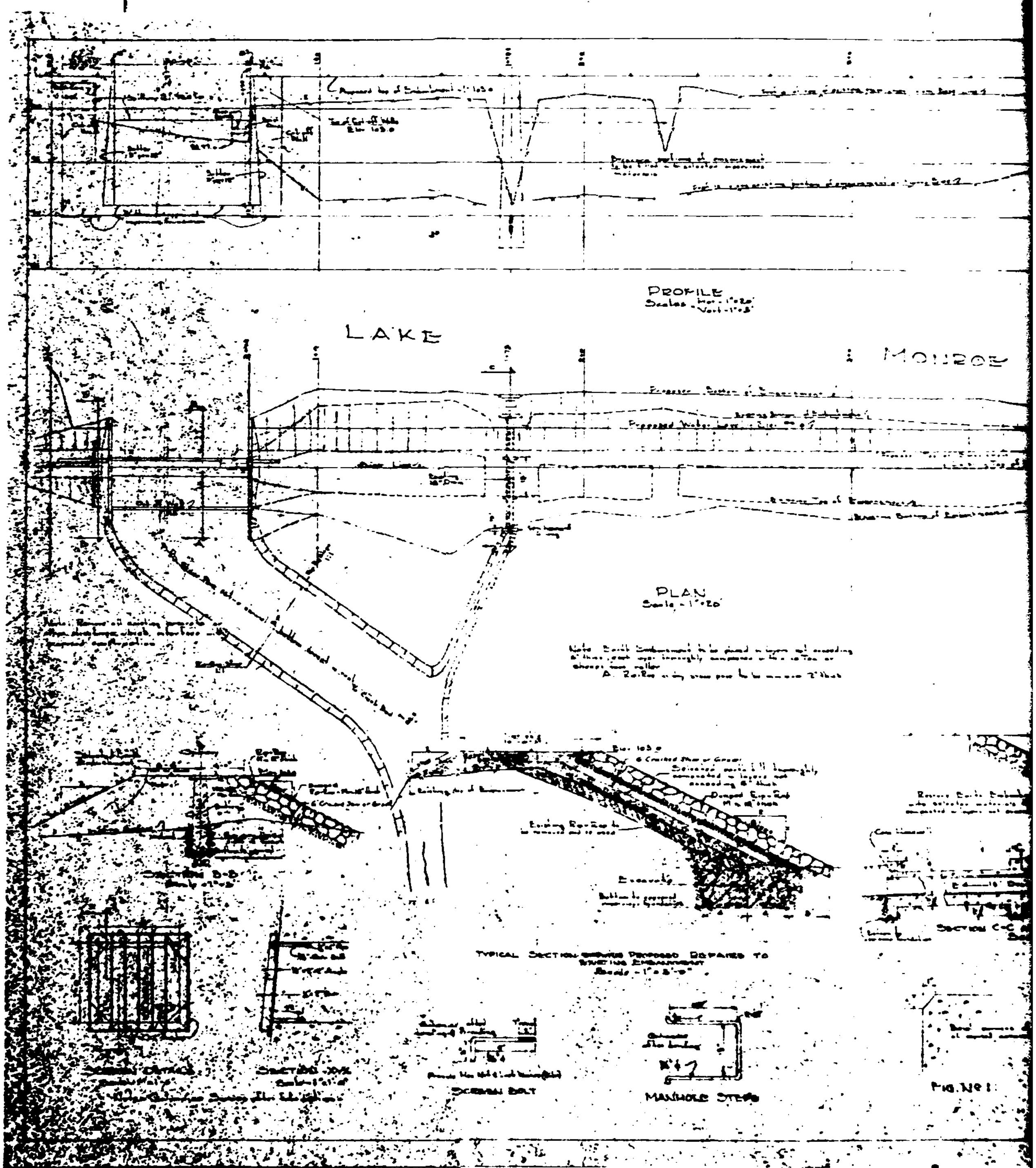


FIGURE 1

REGIONAL VICINITY
AND
WATERSHED BOUNDARY MAP


PROFILE
LAKE
MONROE
PLAN
TYPICAL SECTION SHOWING PROPOSED REPAIRS TO EXISTING EMBANKMENT
SECTION C-C
SCREEN BOLT
MANHOLE STEPS
FIG. No 1

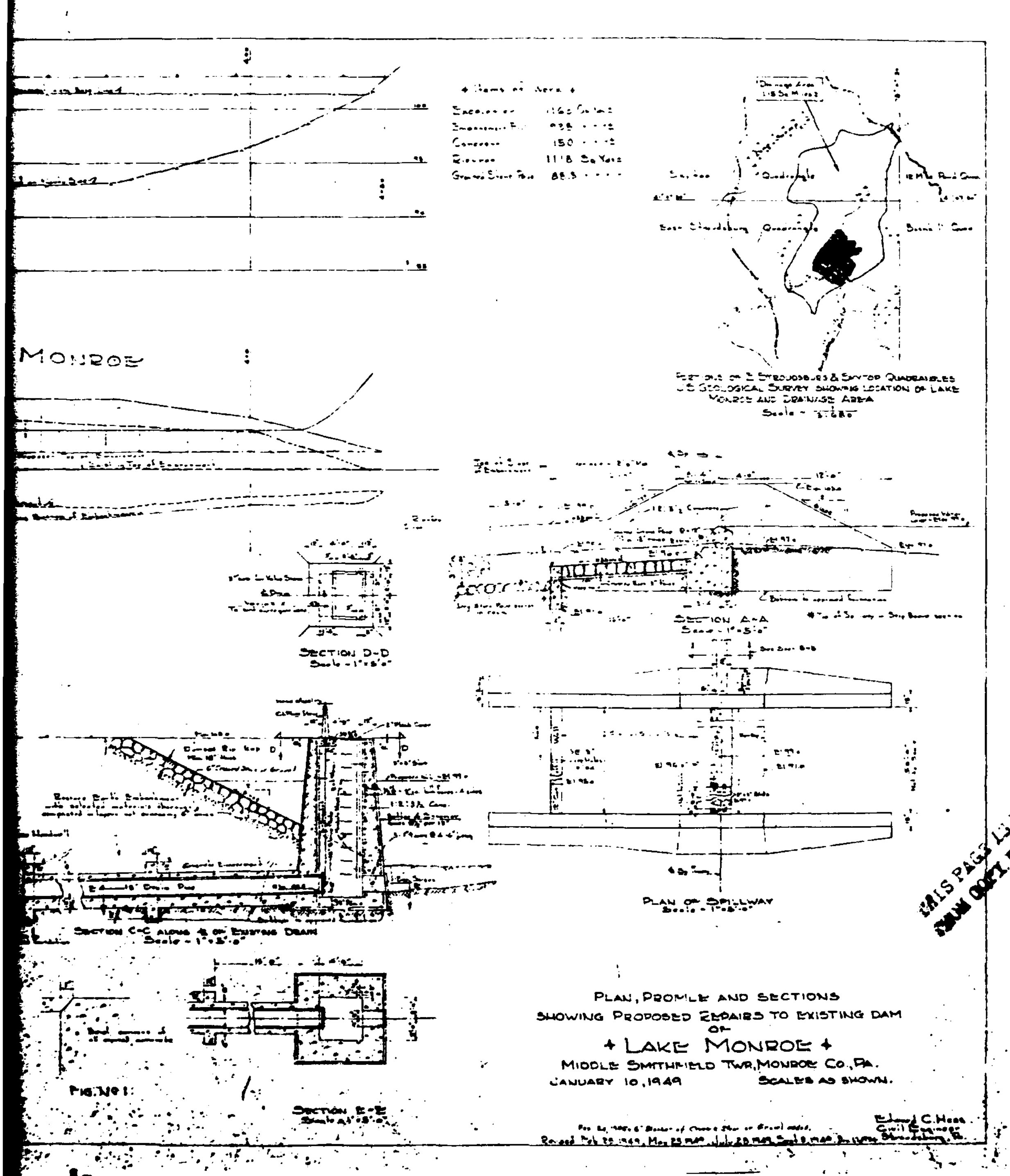


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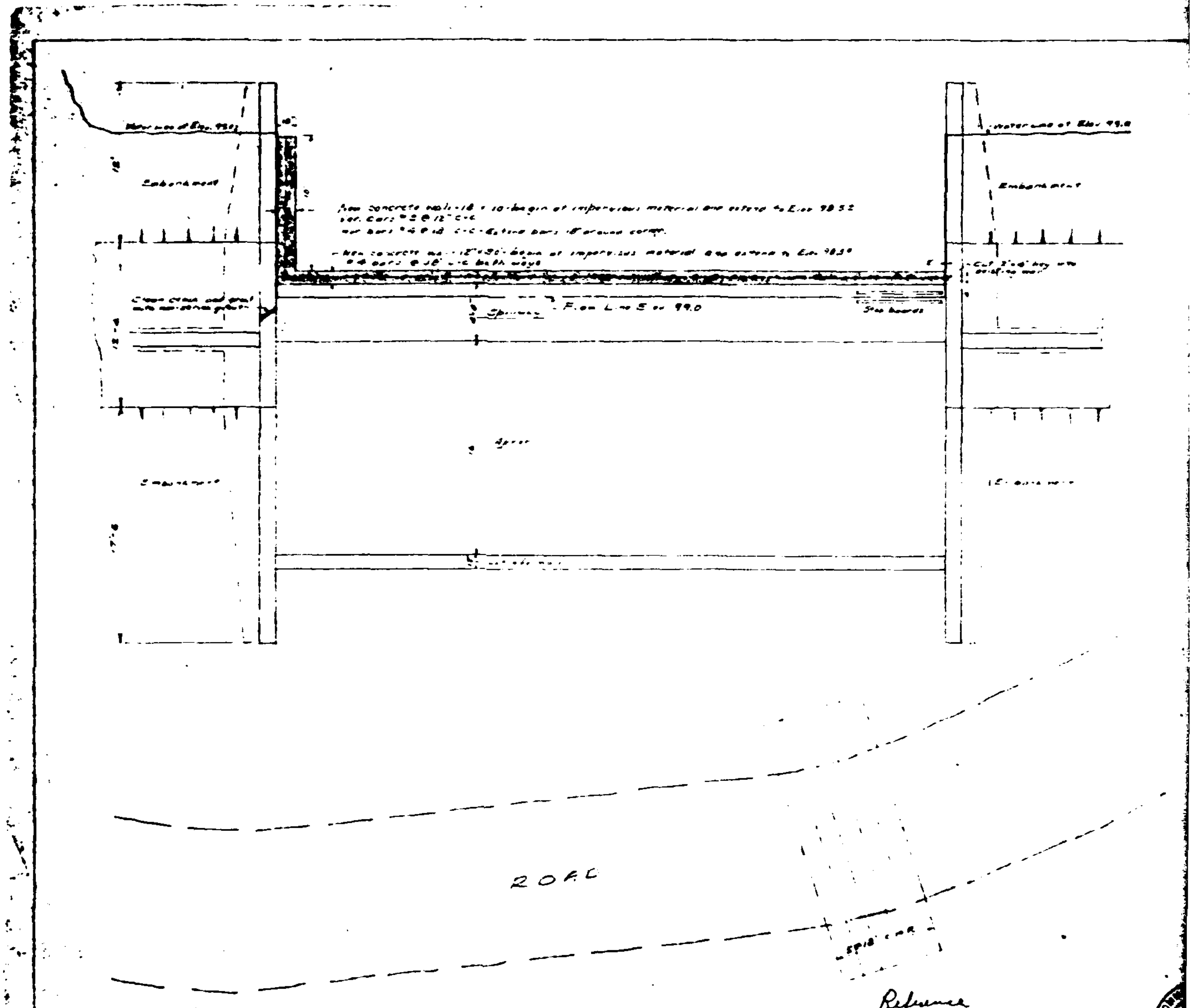
FIGURE 2



PLAN OF SPILLWAY

Reference
WDE 45-117

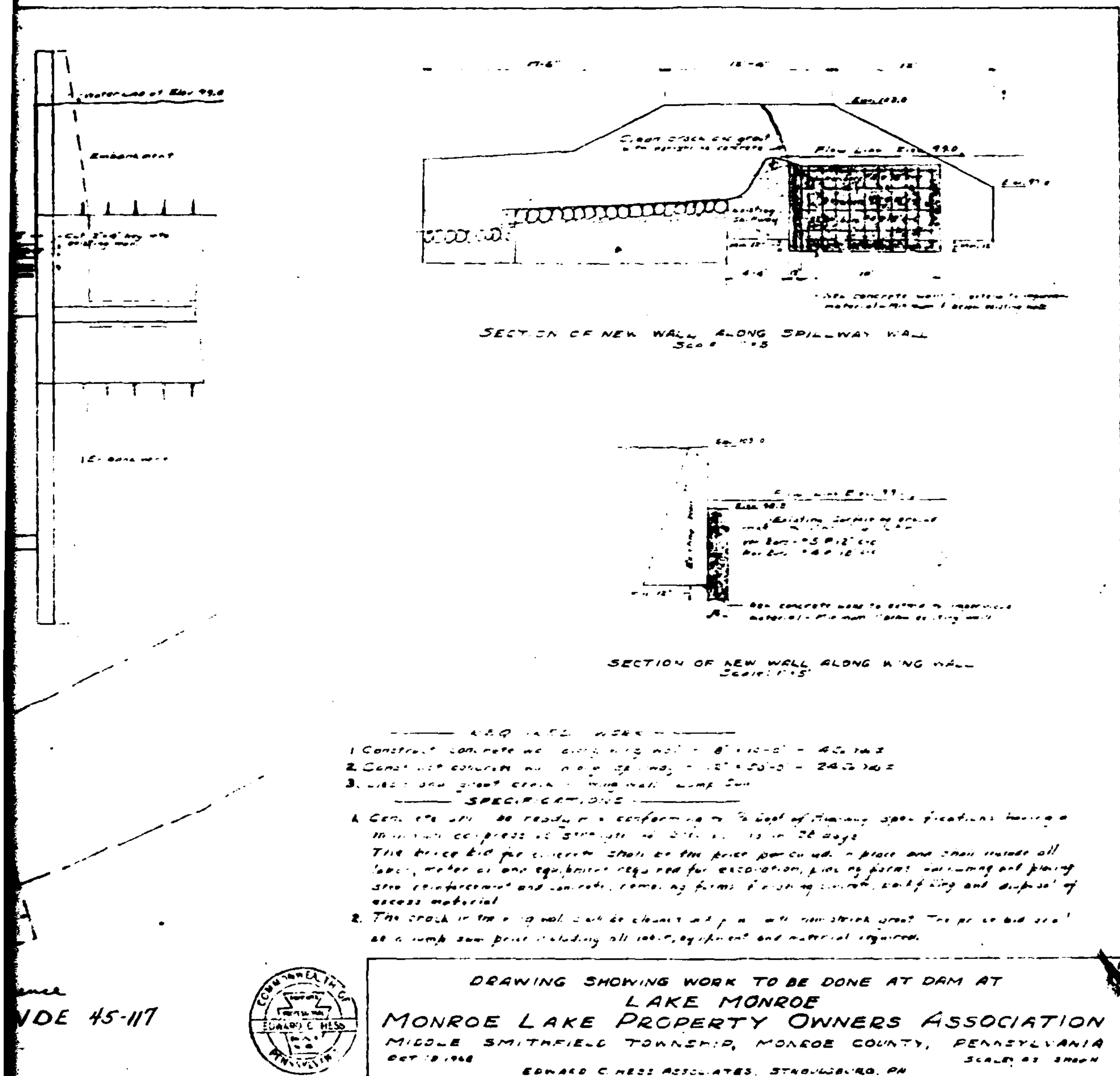


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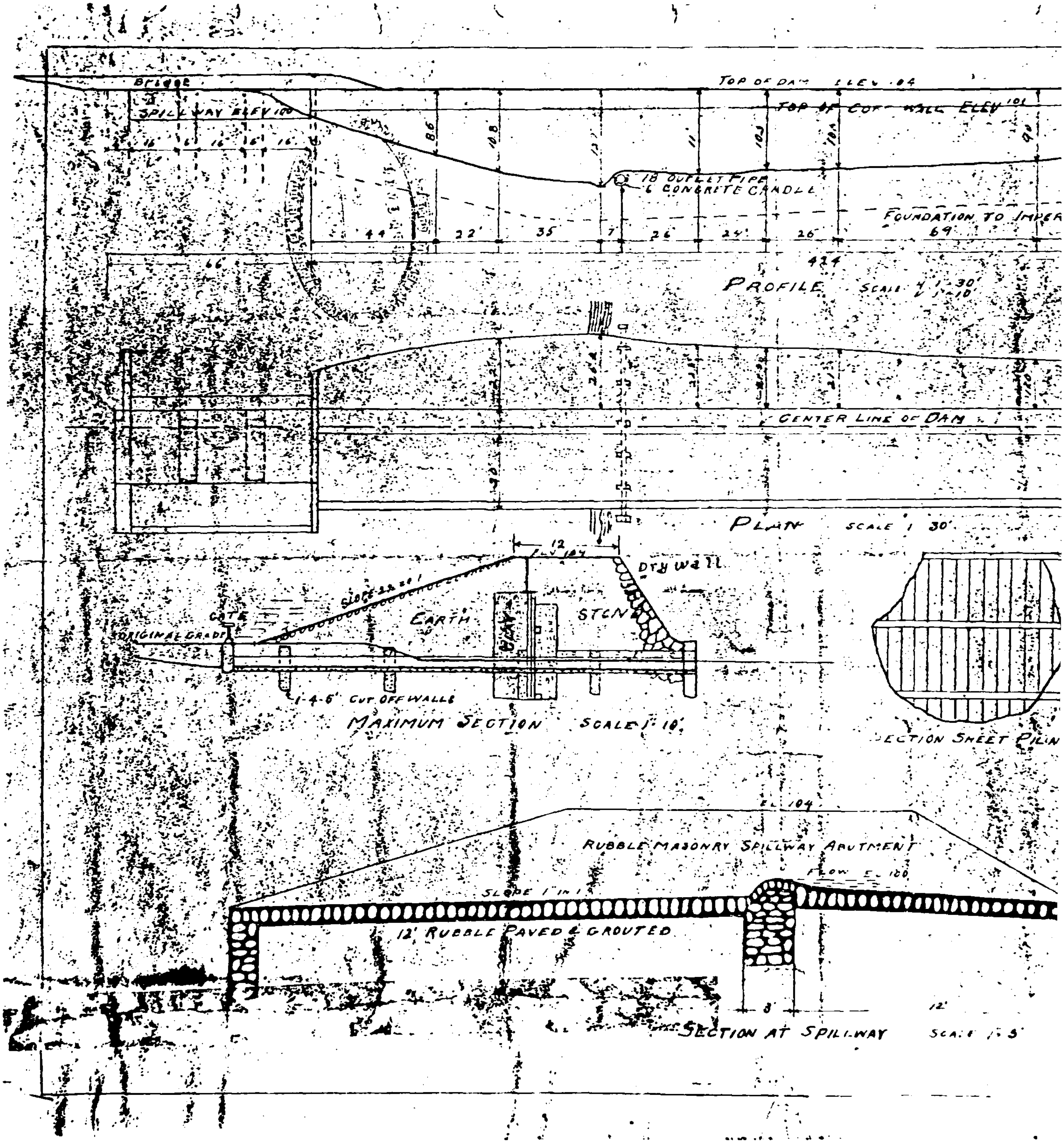
FIGURE 3



Bridge
TOP OF DAM ELEV. 104
SPILLWAY ELEV 100
TOP OF CUT-OFF WALL ELEV 101
18 OUTLET PIPE
6 CONCRETE CRADLE
FOUNDATION TO IMPER
PROFILE
CENTER LINE OF DAM
PLAN SCALE 1 30'
DRY WALL
EARTH
STONE
CLAY
GATE
ORIGINAL GRADE
1-4-6 CUT OFF WALLS
MAXIMUM SECTION SCALE 1" 10'
SECTION SHEET PILIN
EL 104
RUBBLE MASONRY SPILLWAY ABUTMENT
FLOW EL 100
SLOPE 1" IN 1
12' RUBBLE PAVED & GROUTED
SECTION AT SPILLWAY

AD-A097 400   GAI CONSULTANTS INC MONROEVILLE PA   F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. MONROE LAKE DAM (NDI I.D. NUMB--ETC(U)
JAN 81 B M MIHALCIN   DACW31-81-C-0015

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2 of 2

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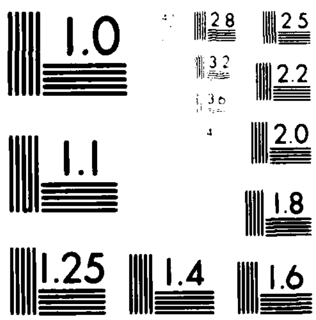

MICROCOPY RESOLUTION TEST CHART

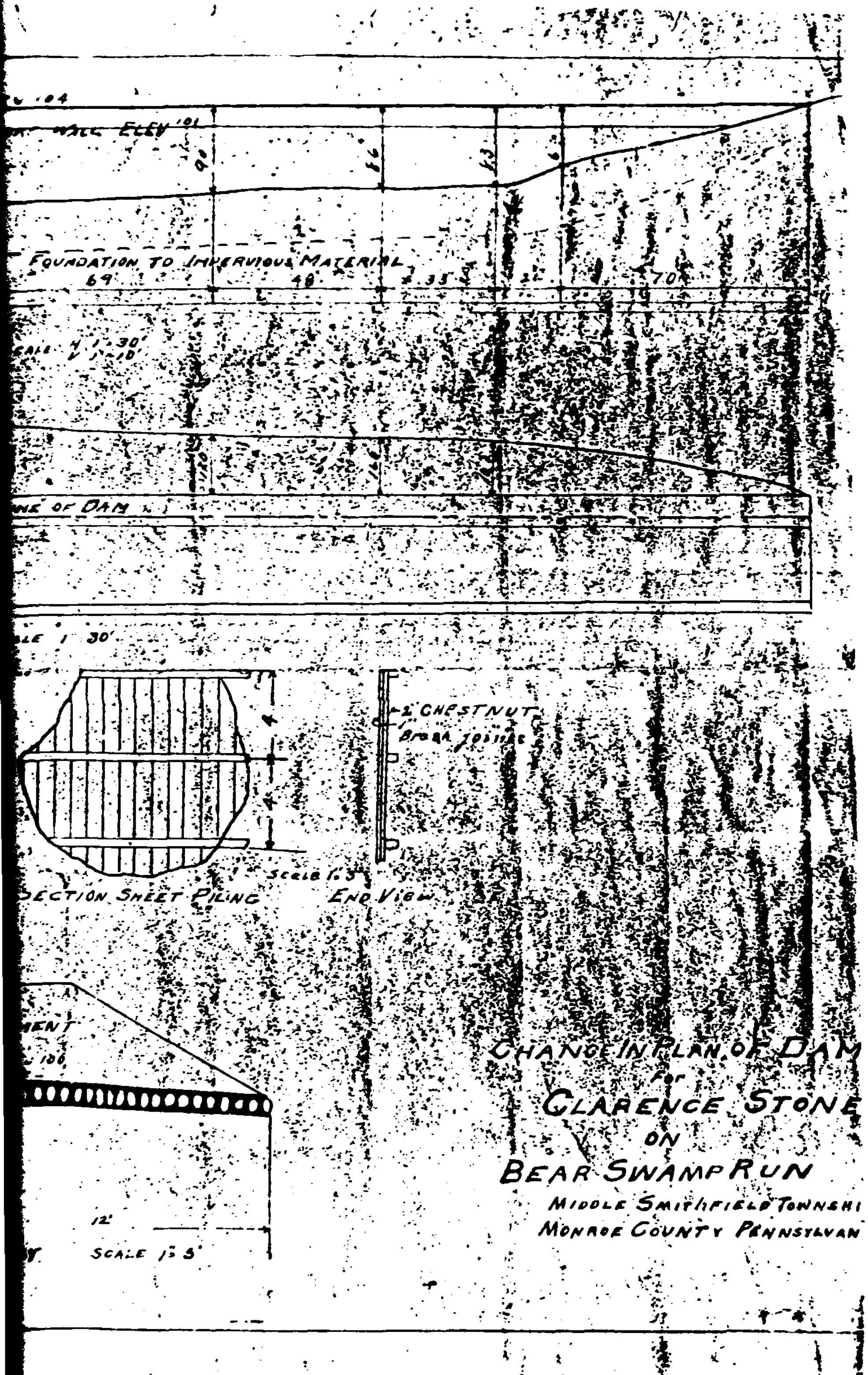

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FIGURE 4

7

APPENDIX F

GEOLOGY

Geology

Monroe Lake Dam is located in the glaciated Pocono Plateaus section of the Appalachian Plateaus physiographic province of eastern Pennsylvania. This area is characterized topographically by northeast-southwest oriented peaks, a low to moderate northward dip and a regional N55°E strike. Numerous small asymetrical anticlines occur with steeply dipping south limbs and gently dipping north limbs. These folds are superimposed upon a broad, regional synclinorium.

The area is covered by a blanket of late Wisconsin age glacial drift, which based on the degree of weathering, was probably deposited during the Woodfordian stage. The drift is a mixture of rock fragments set in a clay-silt-sand matrix and is characteristically a clayey sandy silt to a silty sand, loose to moderately compact. This lithology of the glacial drift suggests that it was derived predominantly from the underlying bedrock by glacial erosion during the ice advance. Specifically, the high sand content of the drift reflects the frequent occurrence of sandstones in the bedrock sequence.

The development of transitional type peat bogs in the area is closely related to the formation of undrained depressions in the glacial drift through modification of preglacial drainage by damming of valleys and plucking of bedrock.

The sedimentary rock sequence underlying the glacial drift in the area of the dam site are members of the Susquehanna Group of Upper Devonian age. From drilling records of seven holes drilled in the Monroe Lake area (Table 5, Atlas 214C, Page 36), the surficial material was described as gravel overlying the Shohola member of the Catskill Formation and varied in thickness from eight to 35 feet. The Shohola member consists of "interbedded 5- to 25- foot thick units of greenish-gray and grayish-red, very fine to medium grained sandstone and sandy shale, and lesser medium-gray to medium dark gray sandstone and shale. Sandstones are predominantely low rank graywackes. Beds are thin to very thick and most have simple or planar sets of small to medium scale, generally low angle cross stratification".

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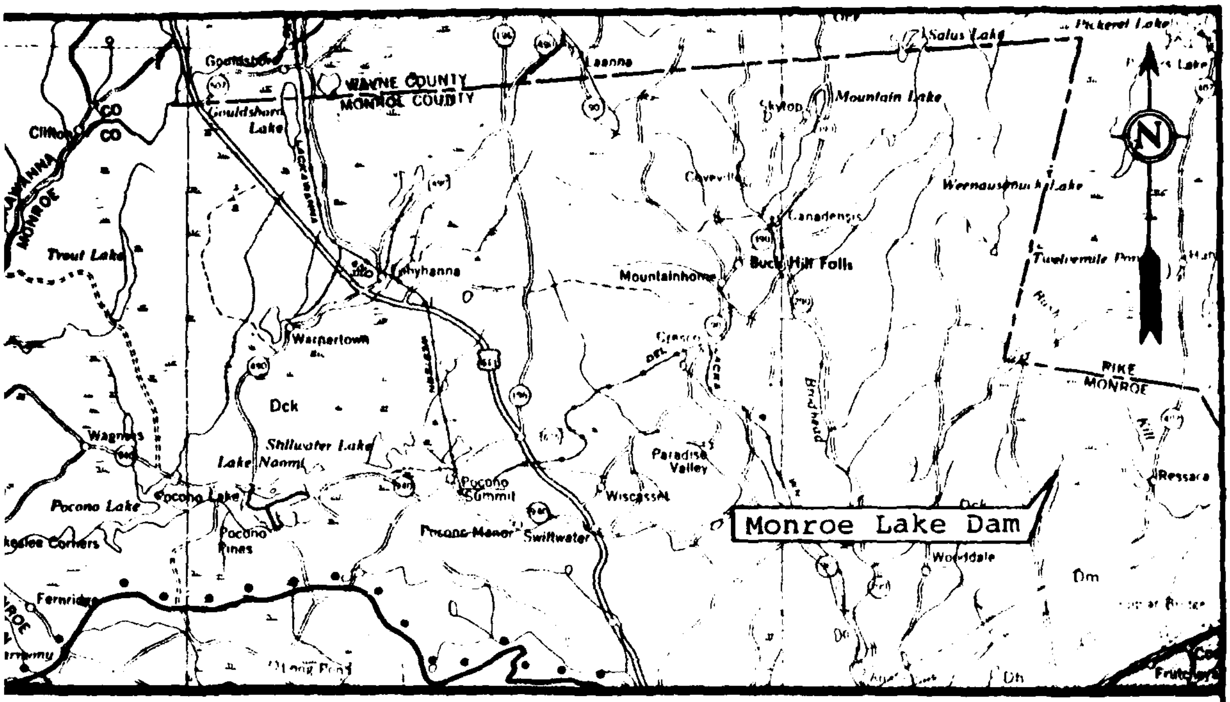

LEGEND

MISSISSIPPIAN

Mp — **Pocono Group**
Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; [illegible] in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations; includes part of "Oswayo" of M. L. Fuller in Potter and Tioga counties.

UPPER DEVONIAN

Dck — **Catskill Formation**
Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

[illegible] — **Marine beds**
Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.

MIDDLE AND LOWER DEVONIAN

Dh — **Hamilton Group**

Dmh — **Mahantango Formation**
Brown to olive shale with interbedded sandstones which are dominant to [illegible]; Montebello highly fossiliferous in upper part; contains "Centerfield coral bed" in eastern Pennsylvania.

Marcellus Formation
Black to dk. carbonaceous shale with thick brown sandstone [illegible] part of central Pennsylvania.

Dho — **Onondaga Formation**
Greenish blue, thin bedded shale and dark blue to black medium bedded limestone with shale, predominant in most places; includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in easternmost Pennsylvania; in Lehigh Gap area includes Palmerton Sandstone and Bowmanstown Chert.

Border of Wisconsin drift

Scale

2 4 6 8 10 MILES

NCE
LOGIC MAP OF PENNSYLVANIA PREPARED
COMMONWEALTH OF PENNA. DEPT. OF INTERNAL
AIRS, DATED 1960, SCALE 1" = 4 MILES

GEOLOGY MAP

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ATE

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